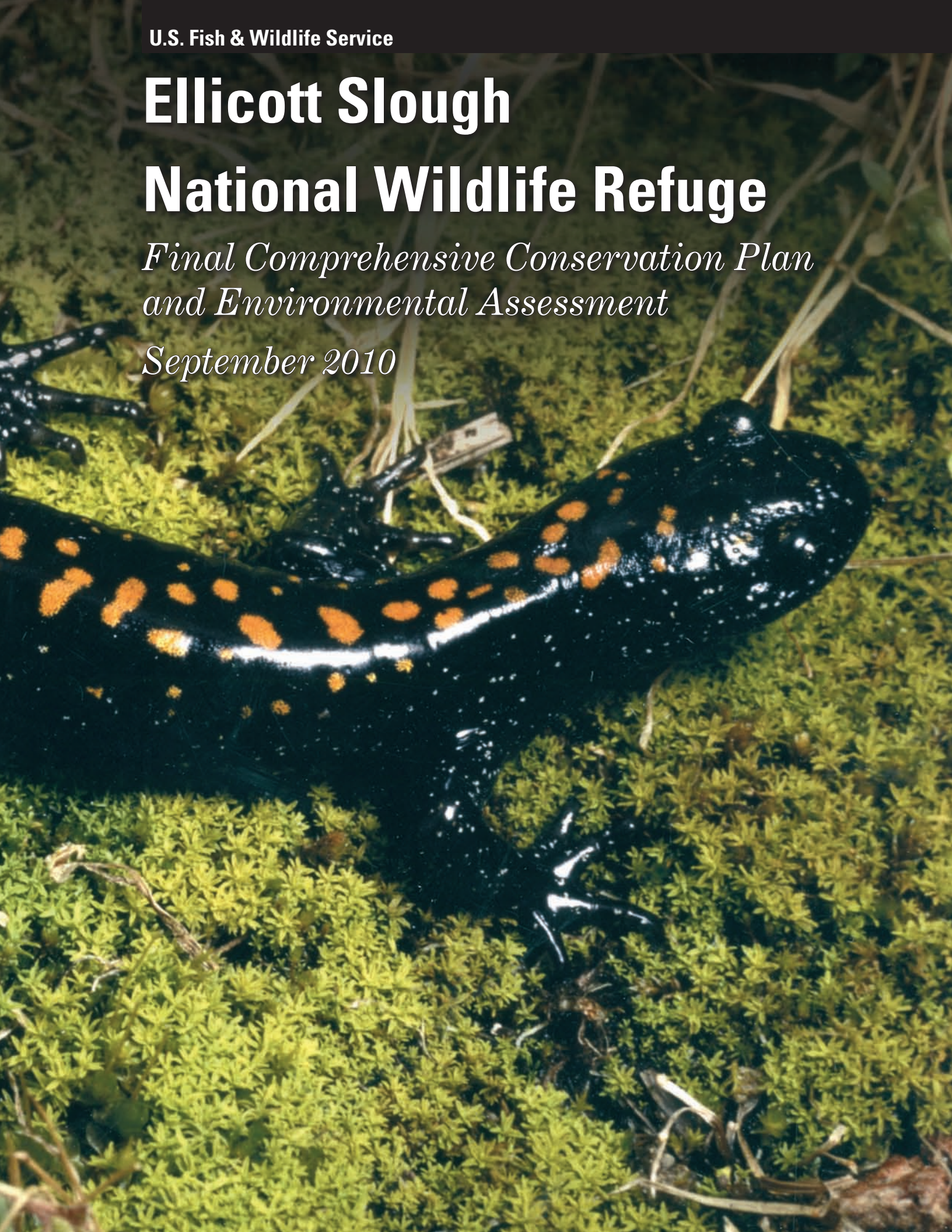
U.S. Fish & Wildlife Service

Ellicott Slough National Wildlife Refuge

Final Comprehensive Conservation Plan and Environmental Assessment

September 2010



Disclaimer

CCPs provide long term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Ellicott Slough National Wildlife Refuge

Final Comprehensive Conservation Plan

Prepared By
U.S. Fish and Wildlife Service
Pacific Southwest Region

San Francisco Bay National Wildlife Refuge Complex
9500 Thornton Avenue
Newark, California 94560
and
Refuge Conservation Planning Branch
2800 Cottage Way, W-1832
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Approved: Alexandra Pitts Date: 9/29/2010
Acting Regional Director

Implementation of this Comprehensive Conservation Plan and alternative management actions/programs have been assessed consistent with the requirements of the National Environmental Policy Act (42 USC 4321 et seq

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Abbreviations and Acronyms

Complex	San Francisco Bay NWR Complex
Ellicott Slough NWR	Ellicott Slough National Wildlife Refuge (Refuge)
Improvement Act	National Wildlife Refuge System Improvement Act of 1997 (or 1997 Improvement Act)
Plan	Comprehensive Conservation Plan (CCP)
Refuge System	The National Wildlife Refuge System (NWRS)
Service	U.S. Fish and Wildlife Service (USFWS)
ATV	All-terrain vehicle
BD	*Batrachochytrium dendrobatidis*
BIDEH	Biological Integrity, Diversity and Environmental Health (601 FW3)
CAL FIRE	California Department of Forestry and Fire Protection
CCC	California Conservation Corps
CCP	Comprehensive Conservation Plan (CCP)
CCAMP	Central Coast Ambient Monitoring Program
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRLF	California red-legged frog
CTS	California tiger salamander
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973, as amended
FMP	Fire Management Plan
FSA	Farm Service Agency
FTE	Full Time Employee
GHG	greenhouse gas
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change

KOA	Kampgrounds of America
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MMT	million metric tons
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NRCS	Natural Resource Conservation Service
NWR	National Wildlife Refuge
NWRS	National Wildlife Refuge System (Refuge System)
PG&E	Pacific Gas and Electric
PUP	Pesticide Use Proposal
RONS	Refuge Operating Needs System
SCCMCV	Santa Cruz County Mosquito and Vector Control
SCLTS	Santa Cruz long-toed salamander
SHPO	(California) State Historic Preservation Office
SLAMM	Sea-level Affecting Marshes Model
SUP	Special Use Permit
TPL	Trust for Public Land
USFWS	U.S. Fish and Wildlife Service (Service)
USGS	U.S. Geological Survey
VOC	volatile organic compounds
WCB	Wildlife Conservation Board
WNV	West Nile Virus
WUI	Wildland Urban Interface

Chapter 1. Introduction and Background

The U.S. Fish and Wildlife Service (Service) manages the Ellicott Slough National Wildlife Refuge (Refuge, Ellicott Slough NWR) located in Santa Cruz County within the Monterey Bay area, California. Established in 1975, the Refuge provides vital habitat for the endangered Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*), the threatened California red-legged frog (*Rana aurora draytonii*), the threatened California tiger salamander (*Ambystoma californiense*), and the endangered robust spineflower (*Chorizanthe robusta*).

The Service prepared this Comprehensive Conservation Plan (CCP, Plan) to guide Refuge management for the next 15 years. The CCP provides a description of the desired future conditions and long-range guidance to accomplish the purposes for which the Refuge was established. The CCP and accompanying environmental assessment (EA) address Service legal mandates, policies, goals, and National Environmental Policy Act (NEPA) compliance.

The CCP is divided into six chapters: Chapter 1, Introduction and Background; Chapter 2, The Comprehensive Conservation Planning Process; Chapter 3, Refuge and Resource Description; Chapter 4, Current Refuge Management and Programs; Chapter 5, Management Direction; and Chapter 6, Plan Implementation.

Ellicott Slough NWR entrance sign. Photo: USFWS

1.1 Purpose and Need for this CCP

No formal management plan currently exists for the Refuge. The National Wildlife Refuge System (Refuge System, NWRS) Improvement Act of 1997 (16 United States Code [USC] 668dd-668ee) (1997 Improvement Act) requires that all refuges be managed in accordance with an approved CCP by 2012. Under the 1997 Improvement Act, the Refuge System is to be consistently directed and managed to fulfill the specific purpose(s) for which each refuge was established as well as the Refuge System Mission. The planning process helps the Service achieve the refuge purposes and the Refuge System mission by identifying specific goals, objectives, and strategies to implement on each refuge. The purposes of this CCP are as follows:

- Provide a clear statement of direction for the management of the Refuge during the lifetime of the CCP.
- Provide long-term continuity in Refuge management.
- Communicate the Service's management priorities for the Refuge to its neighbors and the public.
- Provide an opportunity for the public to help shape the future management of the Refuge.
- Ensure that management programs on the Refuge are consistent with the legal and policy mandates for the Refuge System and the purpose of the Refuge as set forth in establishing documentation.
- Ensure that management of the Refuge is, to the extent practicable, consistent with Federal, state, and local plans.

- Provide a basis for budget requests to support the Refuge's needs for staffing, operations, maintenance, and capital improvements.
- Evaluate existing and proposed uses on each of the Refuges to ensure that they are compatible with the Refuge purpose(s); the Refuge System mission; and the maintenance of biological integrity, biodiversity, and environmental health (or BIDEH).

1.2 The U.S. Fish and Wildlife Service and the National Wildlife Refuge System

1.2.1 U.S. Fish and Wildlife Service

The Service is the primary Federal agency responsible for conserving, protecting, and enhancing the Nation's fish, wildlife, and plant populations and their habitats for the continuing benefit of the American people. Although the Service shares this responsibility with other Federal, tribal, state, local, and private entities, the Service has specific responsibilities for migratory birds, threatened and endangered species, interjurisdictional fish, and certain marine mammals. These are referred to as Federal Trust Species. The Service also manages the National Wildlife Refuge System and National Fish Hatcheries, enforces Federal wildlife laws and international treaties related to importing and exporting wildlife, assists state fish and wildlife programs, and helps other countries develop wildlife conservation programs.

1.2.2 The National Wildlife Refuge System

The National Wildlife Refuge System (Refuge System) is the world's largest collection of lands specifically managed for fish and wildlife conservation. Unlike other Federal lands that are managed under a multiple-use mandate (e.g., National Forests and lands administered by the U.S. Bureau of Land Management, the Refuge System is managed primarily for the benefit of fish, wildlife, and plant resources and their habitats. The Refuge System consists of more than 551 units that provide more than 150 million acres of important habitat nationwide for native plants and many species of mammals, birds, and fish, including threatened and endangered species.

1.2.3 National Wildlife Refuge System Mission and Goals

The mission of the Refuge System is "to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (1997 Improvement Act).

The goals of the Refuge System are:

a. *Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.*

b. *Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.*

c. *Conserve those ecosystems; plant communities; wetlands of national or international significance; and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.*

d. *Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation, and photography, and environmental education and interpretation).*

e. *Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.*

1.3 Legal and Policy Guidance

Refuges are guided by the purposes of the individual refuge, the mission and goals of the Refuge System, Service policy, laws, and international treaties. Relevant guidance includes the Refuge Recreation Act of 1962, the 1997 Improvement Act, and selected portions of the Code of Federal Regulations and the U.S. Fish and Wildlife Service Manual. Refuges are also governed by a variety of other Federal laws, Executive orders (EOs), treaties, interstate compacts, regulations, and policies pertaining to the conservation and protection of natural and cultural resources (see Service Manual 602 FW 1 [1.3]).

1.3.1 The Improvement Act

The 1997 Improvement Act, which amends the National Wildlife Refuge System Administration Act of 1966, serves as an "organic" act for the Refuge System and provides comprehensive legislation describing how the Refuge System should be managed and used by the public. The 1997 Improvement Act's main components include the following.

- A strong and singular wildlife conservation mission for the Refuge System
- A recognition of six priority public uses of the Refuge System (hunting, fishing, wildlife observation and photography, and environmental education and interpretation)
- A requirement that the Secretary of the Interior maintain the biological integrity, diversity, and environmental health of Refuge System lands
- A new process for determining compatible uses on refuges
- A requirement for preparing a Comprehensive Conservation Plan for each refuge by 2012

1.3.2 Refuge System Policies

Refuge System policies are found in the land use management series (600) of the U.S. Fish and Wildlife Service Manual. These policies are available online at www.fws.gov/policy/manuals. Table 1 provides brief descriptions of key policies related to refuge management and use.

1.4 San Francisco Bay National Wildlife Refuge Complex

With the support of citizens and public officials, seven refuges have been established in the San Francisco and Monterey Bay Areas: Farallon NWR (1909), Salinas River NWR (1973), San Pablo Bay NWR (1974), San Francisco Bay NWR (1974), Ellicott Slough NWR (1975), Antioch Dunes NWR (1980), and Marin Islands NWR (1992). These seven refuges, stretching from Monterey Bay to the Sacramento–San Joaquin River Delta, were combined to create the San Francisco Bay NWR Complex (Complex) (Figure 1). These refuges provide a variety of critical habitat, food, and shelter for native plants and animals such as threatened and endangered species, species of special concern, waterfowl, and many others. Unlike refuges in remote locations, each of these seven refuges shares the task of implementing wildlife conservation objectives while addressing human needs in a highly urbanized environment. The Complex is administered from a headquarters office located on the Don Edwards San Francisco Bay NWR, near the city of Fremont.

1.5 Ellicott Slough National Wildlife Refuge

1.5.1 Location

The Ellicott Slough National Wildlife Refuge (Refuge) is located on the southern coast of Santa Cruz County, approximately four miles west of the city of Watsonville. Santa Cruz County is part of the larger Monterey Bay area and is heavily influenced by marine conditions of the Pacific Ocean. This area is small but diverse with mountains, foothills, valleys, and marine scenery. The soil is productive, making the area an important agricultural base. Residential and agricultural development surrounds the Refuge.

1.5.2 Refuge Setting

Present-day Santa Cruz and Watsonville were explored in 1769 by an expedition led by Don Caspar de Portola. Settlers came with the founding of the Santa Cruz Mission in September 1791 (Watkins 1925). Farming was first practiced near the Mission and even continues today. Wheat, corn, and barley were the principal crops, but fruit orchards also existed. Raising livestock was also important. Logging began in 1832, and numerous mills were built to utilize the local timber. California was acquired from Mexico by the United States in 1846. Santa Cruz County was formally organized in 1850. In 1851, farmers settled into Pajaro Valley. In 1858, commercial apple orchards were started, and by 1910, there were a million trees on 14,000 acres. Other crops that were grown from the late 1800s through the 1900s included prunes, hops, sugar beets, strawberries, and lettuce. The farming industry was stimulated greatly when the railroad came into the Pajaro Valley in 1870 (Martin 1911).

Table 1. Key policies related to management of National Wildlife Refuges

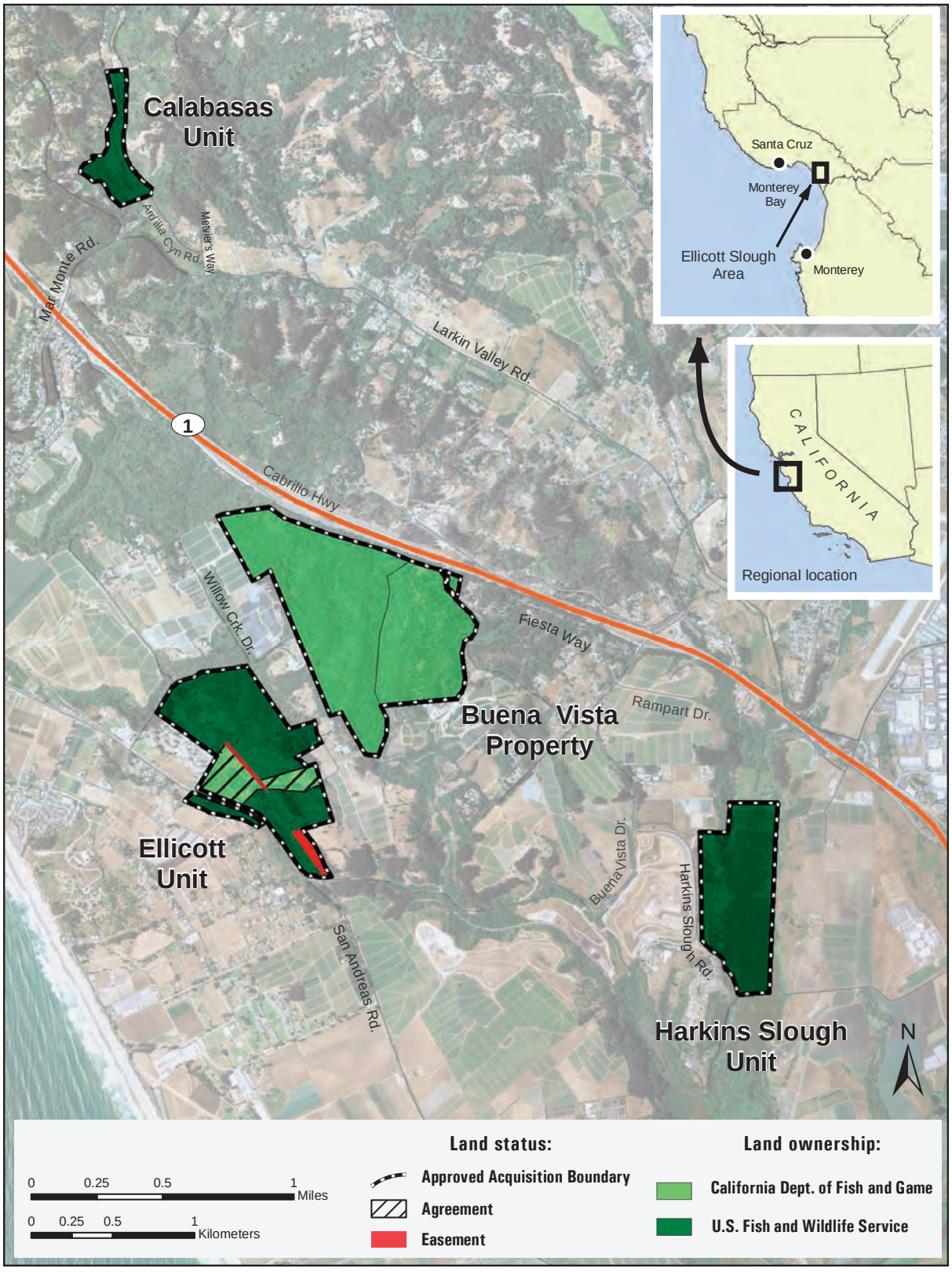
Policy	Purpose
Refuge System Mission and Goals and Refuge Purposes (601 FW 1)	Reiterates and clarifies the Refuge System mission and how it relates to the Service mission; explains the relationship between the Refuge System mission, goals, and purpose(s). It also includes the decision making process for determining refuge purposes.
Biological Integrity, Diversity and Environmental Health Policy (601 FW 3)	Provides guidance for maintaining and restoring, where appropriate, the biological integrity, diversity, and environmental health of the Refuge System.
Comprehensive Conservation Planning (602 FW 3)	Describes the requirements and processes for developing refuge comprehensive conservation plans.
Appropriate Use (603 FW 1)	Describes the initial decision process the refuge manager follows when first considering whether or not to allow a proposed use on a refuge. The refuge manager must find a use appropriate before undertaking a compatibility review of the use.
Compatibility (603 FW 2)	Details the formal process for determining if a use proposed on a National Wildlife Refuge is compatible with the Refuge System mission and the purposes for which the refuge was established. Units of the Refuge System are legally closed to all public access and use, including economic uses, unless and until they are officially opened through a compatibility determination. Appendix G contains several draft compatibility determinations for proposed uses on Ellicott Slough NWR. These will be open to public comment with the Draft Plan and formalized with the Final Comprehensive Conservation Plan.
Wildlife-Dependent Recreation (605 FW 1-7)	Provides specific information and guidance for each of the six priority wildlife-dependent uses: the policy for the use; guiding principles for the use; guidelines for program management; and guidelines for opening the specific program.

1.5.3 History of Refuge Establishment and Acquisition

In 1971, the original owner of the Ellicott Slough area intended to rezone the area to develop it into a trailer park. However, the proposal was denied by the Santa Cruz County commissioners because at the time, the parcel contained one of only two known active breeding ponds for the Santa Cruz long-toed salamander (USFWS 1975). The California Department of Fish and Game (CDFG) later acquired the property and some adjacent upland in 1973 and designated the 30-acre acquisition as a State Ecological Reserve. During that time, salamanders were found in significant numbers in chaparral and oak woodland up to at least a quarter mile from the breeding pond (USFWS 1975). In 1975, the Service acquired additional adjacent upland habitat to protect the salamander's terrestrial lifecycle needs and established Ellicott Slough NWR. Beginning with 41 acres in 1975, 87 acres were added the following year to make up the 128-acre Ellicott Unit. The 30-acre State Ecological Reserve is included in the Ellicott Unit and is managed by the Refuge under a Memorandum of Understanding (MOU) with the CDFG. Two easements are also associated with the Ellicott Unit. The Fisher family contributed a 1.12-acre

Figure 1. San Francisco Bay NWR Complex Map

Figure 2. Ellicott Slough NWR Location Map



conservation easement in 1975, and the Lima family contributed a 4.50-acre conservation easement in 1994. Both easements are within the approved Refuge boundary. In total, the 133.24 acres owned in fee title by the Service and the 35.11 acres managed under easement or agreement comprise the 168.35-acre Ellicott Unit today.

In June 1999, the Calabasas Unit was added to the Refuge. A single-family home was slated for development on this nearly 32-acre parcel but was halted due to seismic, septic, and endangered species restrictions (Santa Cruz long-toed salamander and California red-legged frog were found on the property). In 1999, The Trust for Public Land (TPL) obtained an option to purchase the site, with the intention to sell it to the Wildlife Conservation Board (WCB) (USFWS 1999c). The WCB was then awarded a Cal Trans Environmental Enhancement and Mitigation grant to purchase Calabasas for $250,000. The WCB transferred the unit, at no cost, to the Service to maintain its coastal scrub and pond habitat.

The Harkins Slough Unit was formerly an agricultural property farmed for over 40 years by the Bencich family. It was reclaimed by the Farm Service Agency in 1994 when flooding from the Harkins Slough waterway permanently inundated the agricultural fields. The 116-acre property was then transferred to the Service in 2005 due to its value as freshwater wetland habitat for migratory birds.

The Ellicott Unit (168.35 acres), the Calabasas Unit (31.20 acres), and the Harkins Slough Unit (116 acres) together comprise the Ellicott Slough NWR, totaling 315.55 acres.

The 289-acre Buena Vista property was acquired by TPL in 2004. Originally, a golf course had been planned for the property until the Santa Cruz long-toed salamander and California tiger salamander were found to breed in the manmade ephemeral pond on site. TPL led efforts to acquire the land, with support from state agencies. This property was later transferred to the CDFG. The Service is working with CDFG to develop an agreement to cooperatively manage the property that is within the approved acquisition boundary for the Refuge. See Figure 2.

1.5.4 Refuge Purposes

Lands within the Refuge System are acquired and managed under a variety of legislative acts and administrative orders and authorities. The official purpose or purposes for a refuge are specified in or derived from the law, proclamation, executive order, agreement, public land order, funding source, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit, or refuge subunit. The purpose of a refuge is defined when it is established or when new land is added to an existing refuge. When an addition to a refuge is acquired under an authority different from the authority used to establish the original refuge, the addition takes on the purposes of the original refuge, but the original refuge does not take on the purposes of the addition. Refuge managers must consider all of the purposes. However, purposes that deal with the conservation, management, and restoration of fish, wildlife, and plants and their habitats take precedent over other purposes in the management and administration of a refuge (601 FW 1.5).

The Refuge System Improvement Act directs the Service to manage each refuge to fulfill the mission of the Refuge System, as well as the specific purposes for which that refuge was established. Refuge purposes are the driving force in developing refuge vision statements, goals, objectives and strategies in the CCP. Refuge purposes are also critical to determining the compatibility of all existing and proposed refuge uses.

Ellicott Slough National Wildlife Refuge was established under the authority of two acts. These acts and the corresponding purposes are:

> Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) - "…to conserve (A) fish or wildlife which are listed as endangered species or threatened species .... or (B) plants ..."
>
> Emergency Wetlands Resources Act of 1986 (16 U.S.C. 3901-3932) - "... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ..."

1.5.5 Ecosystem Context and Related Projects

To the extent possible, a CCP will assist in meeting conservation goals established in existing national and regional plans, state fish and wildlife conservation plans, and other landscape-scale plans covering the same watershed or ecosystem in which the refuge resides (602 FW 3.3). The Refuge falls within the Central California Ecoregion. This ecoregion consists of mountains, hills, valleys, and plains in the southern Coast Ranges of California. It is close enough to the Pacific Ocean for the climate to be modified greatly by marine influence. The purpose of establishing these ecoregions is to develop and implement goals, priorities, objectives, and actions that will ensure an "ecosystem approach" to fish and wildlife conservation.

1.5.6 Conservation Priorities and Initiatives

The conservation priorities for Federally-listed endangered and threatened species that are present at a refuge are frequently reinforced by recovery plans, conservation plans, and designation of critical habitat. The primary conservation priority for the Ellicott Slough NWR is recovering and conserving the Santa Cruz long-toed salamander and other sensitive amphibians. A revised recovery plan has been developed to guide recovery efforts (USFWS 1999b). The recovery plan has been used to develop some of the objectives and strategies in this CCP.

The Refuge also provides breeding habitat for California red-legged frog and California tiger salamader (CTS), both of which are Federally-listed threatened species. A recovery plan was completed for California red-legged frog in 2002, and critical habitat was re-designated for the species in 2010. Critical habitat for California red-legged frog can be found on the Ellicott and Harkins Slough Units, as well as the Buena Vista Property. The CTS is Federally listed as threatened in Central California and endangered in other parts of California (Santa Barbara and Sonoma Counties). Critical habitat was designated for all CTS populations in 2005, however it does not include Santa Cruz County.

In addition to threatened and endangered amphibians, the Refuge supports the endangered robust spineflower. A recovery plan for robust spineflower was completed in 2004 (USFWS 2004a) and critical habitat was designated in 2002. Critical habitat for spineflower can be found at the Buena Vista property. While it is not known whether the Federally-listed as threatened Santa Cruz tarplant is present at the Refuge, there is designated critical habitat at the Harkins Slough Unit.

1.5.7 Adaptive Management

The Service acknowledges that much remains to be learned about the species, habitats, and physical processes that occur on the Refuge and about the ecological interactions between them. It follows that uncertainty is an unavoidable component of managing natural systems because of the inherent variability in these systems and gaps in the knowledge of their functions. Adaptive management strives to reduce some of that uncertainty and improve management over time. It is an iterative process of evaluating and refining management based on the results of management activities and the status of the managed resource. The Service has been practicing adaptive management on the Refuge since 1991 and plans to continue the practice. Accordingly, the management scenario proposed in this CCP provides for ongoing adaptive management of the Refuge; its adaptive management component is described more fully in Chapter 6, *Plan Implementation*.

Chapter 2. The Comprehensive Conservation Planning Process

This CCP/EA for the Refuge is intended to meet the dual requirements of compliance with the 1997 Improvement Act and NEPA of 1969 (42 USC 4321). The development of this CCP/EA was also guided by the Refuge Planning Policy outlined in Part 602, Chapters 1, 3, and 4 of the Service Manual (USFWS 2000). Service policy, the 1997 Improvement Act, and NEPA provide specific guidance for the planning process. For example, Service policy and NEPA require the Service to actively seek public involvement in the preparation of environmental documents such as EAs.

The purpose of the EA is to evaluate and disclose the environmental effects of the management actions detailed in the proposed action and alternatives on the quality of the human environment. NEPA requires the Service to give serious consideration to all reasonable alternatives, including the "no action" alternative, which represents continuation of current conditions and management practices. Alternative management scenarios were developed as part of the planning process and can be found in Appendix C (Environment Assessment).

2.1 The Planning Process: How the CCP was Developed

Key steps in the CCP planning process are as follows and are depicted in the CCP Process diagram.

1. Preplanning.
2. Identifying issues and developing a vision statement.
3. Gathering information.
4. Analyzing resource relationships.
5. Developing alternatives and assessing environmental effects.
6. Identifying a preferred alternative.
7. Publishing the draft CCP and NEPA document.
8. Documenting public comments on the Draft Plan.
9. Preparing the final CCP.
10. Securing approval of the Regional Director.
11. Implementing the plan.

The CCP may be amended as necessary at any time in keeping with the adaptive management strategy. Major revisions would require public involvement and NEPA review.

2.1.1 Preplanning

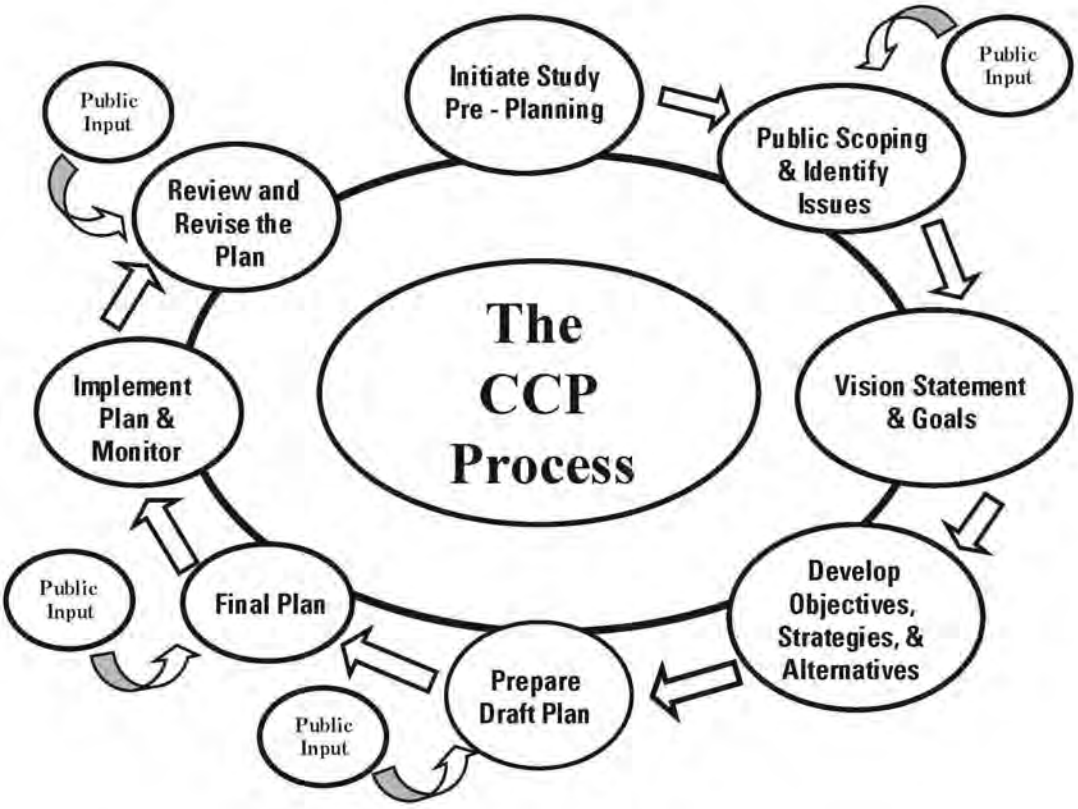
The planning process for this CCP began in January 2008 with the collection of pertinent data and selection of team members. A core team and an extended team were formed to integrate stakeholder input into the planning process (see Appendix I). Refuge staff identified four primary areas of focus: wildlife management, habitat management, wildlife-dependent recreation, and environmental education. These areas helped focus comments received from the public during the scoping period into potential objectives and strategies for the CCP.

2.1.2 Planning Hierarchy

The Service's planning hierarchy, which determines the direction of the goals, objectives, and strategies, is a natural progression from the general to the specific. Described as a linear process, the planning hierarchy is rather a multi-dimensional flow that is linked by the refuge purposes, missions, laws, mandates, and other statutory requirements.

- The refuge purposes provide direction for the refuge.
- A refuge vision broadly reflects the refuge purpose(s), the Refuge System mission and goals, other statutory requirements, and larger-scale plans as appropriate.
- Goals define general targets in support of the vision.

Figure 3. The CCP Process Diagram



- Objectives direct effort into incremental and measurable steps toward achieving goals.
- Strategies identify specific tools to accomplish objectives.

In practice, the process of developing vision, goals, and objectives is iterative and dynamic. During the planning process or as new information becomes available, the plan continues to develop.

2.1.3 The Core Planning Team

The planning team responsible for leading the CCP effort included Service planners, the Refuge manager, the Refuge biologist, and visitor services staff from the San Francisco Bay NWR Complex. The members were responsible for researching and generating the contents of the CCP document and participated in the entire planning process. Representatives from the California Department of Fish and Game (CDFG) were also invited to participate. Appendix I lists the members of the core team and other participants.

2.1.4 The Extended Planning Team

The extended team is the advisory forum of the CCP process. Its role is significant because of the Refuge's history of networking and partnerships with local, state and Federal agencies, community groups, research institutes, and non-profit organizations concerned with the Refuge. Service staff identified several participants including state and Federal agency officials, local government officials, non-profit organizations, community groups, and other interested parties. The goal of the extended team is to provide technical comments on the goals, objectives, and strategies of the CCP to improve the Service's decision-making process. Appendix I lists the members in the extended team.

2.2 Public Involvement in Planning

Public involvement is an important and required component of the CCP and NEPA processes. Public outreach allows the Service to provide updated information about the Refuge System and the Refuge. More importantly, public involvment allows Refuge staff to hear public comments, concerns, and opportunities. Public input can identify important issues regarding the Refuge and its surrounding area.

A Notice of Intent to prepare a Comprehensive Conservation Plan (CCP) and Environmental Assessment was published in the Federal Register on July 14, 2008. A planning update, which introduced the Refuge and the planning process, was mailed to over 100 agency and organization representatives, members of the public, media, and elected representatives in Santa Cruz County. The Refuge held a public scoping period from July 14 through August 13, 2008. During this period, upon request, the Refuge staff met or spoke directly with neighbors and partner organizations, including Watsonville Wetlands Watch on October 2, 2008. The substance of the comments or issues identified through the scoping process is summarized in the *Issues, Concerns, and Opportunities* section that follows.

2.2.1 Issues, Concerns, and Opportunities Identified through Scoping

- Public trespass (e.g., bicycling, hiking, horseback riding, dog walking) occurs on the Refuge units.
- Illegal fishing occurs on the Harkins Slough Unit.
- Vehicular traffic is a major cause of amphibian mortality, and roads exist between breeding ponds and over-summering habitat.
- Invasive plants (e.g., eucalyptus: *Eucalyptus spp.*), pampas or jubata grasses (*Cortaderia spp.*), poison hemlock (*Conium maculatum*), New Zealand spinach (*Tetragonia tetragonioides*), and mustard (*Brassica sp.*) continue to threaten native habitats.
- Intense farming in the area may employ practices (such as pesticide and fertilizer use) that have potentially adverse effects on amphibians.
- Drought years severely impact Santa Cruz long-toed salamander (SCLTS) productivity and make it difficult to assess the status of SCLTS and California tiger salamander (CTS) populations.
- Occasional chytrid fungus (*Batrachochytrium dendrobatidis)* outbreaks cause chytridiomycosis, which threaten amphibian health.
- Mosquito control has been allowed in the past for nuisance and health reasons; however, the potential effects of control to amphibians are still being evaluated.
- Invasive predators of amphibians (e.g., bullfrog, crayfish) tend to multiply quickly and have the potential to decimate native amphibian populations.
- The effects of climate change (e.g., temperature fluctuations and narrowing wildlife habitat ranges) on Refuge resouces. (For more information on climate change, see Chapter 3.)

2.2.2 Additional Management Issues Identified by Staff through Scoping

- Illegal off-road vehicle use, such as all-terrain vehicle (ATV) and motorcycle, in the upland and pond habitats on the Calabasas Unit.
- Few remaining upland habitats and ponds for the SCLTS, CTS, and other native amphibians due to habitat loss from development.
- Known SCLTS and CTS sites are non-contiguous, preventing population exchange.
- Existing Refuge data on SCLTS and CTS is sparse, limiting understanding of population trends and habitat use.
- Amphibian malformation outbreaks caused by trematode parasites.

2.3 Development of Refuge Vision

A vision statement is developed or reviewed for each individual refuge unit as part of the CCP process. Vision statements are grounded in the unifying mission of the Refuge System and describe the desired future conditions of the refuge in the long term (more than 15 years). A vision statement is based on the refuge's specific purposes, the resources present on the refuge, and any other

relevant mandates. Chapter 5 presents the vision statement for the Refuge.

2.4 Development of Refuge Goals, Objectives and Strategies

The purpose for creating the Refuge was established by law, Executive Order, and other mechanisms described in Chapter 1. The 1997 Improvement Act directs that the planning effort develop and revise the management focus of the Refuge within the Service's planning framework-that is, the Service mission, the Refuge System mission, ecosystem guidelines, and refuge purposes. This is accomplished during the CCP process through the development of goals, objectives, and strategies. Chapter 5 includes the goals, objectives and strategies developed for the Refuge.

2.4.1 Goals

Refuge goals are necessary for outlining the desired future conditions of a refuge in clear and succinct statements. The Refuge System defines goals as a "…descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units" (602 FW 1). Each goal is subdivided into one or more objectives that define these desired conditions in specific, measurable, and time-bounded terms. A well-written goal directs work toward achieving a refuge's vision and, ultimately, the purpose(s) of a refuge. Collectively, a set of goals is a framework within which to make decisions.

2.4.2 Objectives, Rationale, and Strategies

After the refuge goals have been reviewed and revised, various objectives, a rationale, and strategies are developed to accomplish each of the goals.

Objectives: An objective is defined as a "concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work" (602 FW 1). Objectives are incremental steps taken to achieve a goal. They are derived from goals and provide a foundation for determining strategies, monitoring refuge accomplishments, and evaluating success. The number of objectives per goal can vary but should be developed to comprise those necessary to satisfy the goal. In cases where there are many objectives, an implementation schedule may be developed. All objectives must possess the following five properties: specific, measurable, achievable, results-oriented, and time-fixed.

Rationale: Each objective should be supported by a rationale. The degree of documentation can vary, but at a minimum, the rationale should include logic, assumptions, and sources of information. Articulating a rationale promotes informed debate on the objective's merits, provides continuity in management through staff turnover, and allows reevaluation of the objective as new information becomes available.

Strategy: A strategy is a "specific action, tool, technique, or combination of actions, tools, and techniques used to meet unit objectives" (602 FW 1). Well-written goals, objectives, and strategies direct work toward achieving the refuge's vision and purpose. Multiple strategies can be necessary to support an objective.

2.5 Development of Alternatives

The CCP process includes the development of a range of reasonable alternatives that can be implemented to meet the goals of the Refuge System and the purpose of the Refuge. The Refuge System defines alternatives as "…different sets of objectives and strategies or means of achieving refuge purposes and goals, helping fulfill the Refuge System mission, and resolving issues…" (602 FW 1). NEPA also requires analysis of a *no-action alternative*, which constitutes a continuation of current conditions and management practices. Development of action alternatives is based on consideration of input from the scoping period, as well as on input from the planning team and other Service staff. The EA (Appendix C) describes the development of alternatives and assessment of their environmental effects, and it identifies the preferred management alternative (proposed action). Once a preferred alternative is selected, it is developed as the objectives and strategies of the CCP.

Three alternatives were identified for analysis; these are discussed in detail in the EA (Appendix C).

2.6 Selection of the Refuge Proposed Action

The alternatives were analyzed in the EA (Appendix C) to determine their effects on the Refuge environment. Based on this analysis, Alternative B was selected as the proposed action because it best achieves the Refuge goals and purposes in accordance with Refuge System and Service missions. Alternative B is founded upon the need for restoring habitat, protecting wildlife, and focusing research and monitoring programs on priority needs. The alternative also integrates environmental education, outreach, and wildlife-dependent recreation objectives that will connect the public to the Refuge. The management plan set forth in Alternative B is described in Chapter 5, *Management Direction*, and Chapter 6, *Plan Implementation*.

2.7 Plan Implementation

The CCP will be reviewed by Refuge staff to coordinate annual work plans and update the Refuge Operational Needs System database. This database describes the unfunded budget needs for each refuge and is the basis upon which the Refuge receives funding increases for operational needs. The CCP may also be reviewed during routine inspections or programmatic evaluations. Results of the reviews may indicate a need to modify an integral part of plan implementation, and management activities may be modified if the desired results are not achieved. If minor changes are required, the level of public involvement and NEPA documentation will be determined by the Refuge manager. The CCP will be formally revised about every 15 years.

Santa Cruz long-toed salamander juveniles. Photo: USFWS

Chapter 3. Refuge and Resource Description

3.1 Geographic/Ecosystem Setting

The Refuge is located in Santa Cruz County, one-half mile inland from Monterey Bay and four miles west of Watsonville. The Refuge falls within the Central California Ecoregion. This ecoregion consists of mountains, hills, valleys, and plains in the southern Coast Ranges of California. It is close enough to the Pacific Ocean for the climate to be modified greatly by marine influence. Elevation ranges from sea level to 3,800 feet. The Refuge is located in the Watsonville Slough system where surface waters converge and eventually terminate into Monterey Bay.

3.2 Description by Refuge Unit

3.2.1 Ellicott Unit

The main Ellicott Unit is located on Peaceful Valley Drive off of San Andreas Road. A privately operated Kampgrounds of America (KOA) campground lies on the western border, and approximately seven houses, agricultural fields, and several small businesses are located in the valley along the eastern border. Scattered houses are located on the northern and southern boundaries. Several California State Parks, open to the public, (Manresa and Sunset State Beaches) are also within two miles of the Ellicott Unit. The nearby agricultural areas are dominated by cash crops such as artichokes, strawberries, broccoli, lettuce, cauliflower, and cut flowers.

Ellicott Unit. Photo: USFWS

The dominant habitats found on the Ellicott Unit are northern coastal shrub, San Andreas coastal live oak woodland, riparian woodland, closed-cone coniferous forest, and coastal grassland. In addition to the Santa Cruz long-toed salamander (SCLTS), California tiger salamander (CTS) and small populations of the robust spineflower have also been identified as Federally-listed species present on the unit.

Past uses on the unit include livestock grazing, farming of berry crops, and off-road vehicle use. A residential house was also located on the property and was demolished prior to Refuge acquisition.

The ephemeral Ellicott Pond on the Ellicott Unit is used by salamanders during breeding. It is unknown whether the Ellicott Pond is naturally occurring or man-made. In 1997, the Refuge attempted to create an additional breeding pond on the unit (Prospect Pond). A pond area was excavated, and a partial earthen berm was constructed to surround the site. Water levels were to be controlled by a culvert installed through the earthen berm. A well was also established on the hilltop above the pond to augment water levels as needed. Plastic piping was laid from the well to the pond site. A temporary pump and generator were needed to transport the water. Subsequent years resulted in poor water retention. The pond dried too early in the season to ensure larvae and tadpole metamorphosis, and water augmentation from the well would have been needed throughout the entire spring and summer. Initial monitoring surveys showed limited Pacific tree frog (*Pseudacris*

regilla) use. In 2004, a hydrologic survey of the area was conducted, and a new pond design was developed. The Service sees a need for further study of the hydrologic conditions and possible causes of the poor water retention.

3.2.2 Calabasas Unit

The Calabasas Unit is located within the upper portion of Larkin Valley area, parallel to Larkin Valley Road where it intersects Mar Monte Avenue. It is bordered to the west by Milky Way and to the east by a dirt fire road. Ardilla Canyon Road is to the south of the unit. The Calabasas Unit is surrounded by residential properties and houses. Several horse stables and horse pastures are also located nearby.

The dominant habitats found on the Calabasas Unit are northern coastal shrub, riparian woodland, coastal grassland, San Andreas coastal live oak woodland, and ephemeral pond.

Historically, Calabasas Pond was a reservoir with an earthen dam across the southern end, and the upland habitat was grazed by livestock. Santa Cruz County Public Works intentionally breached a section of the dam about 1980, after it was determined to be structurally unsound. This breach created the existing hydrologic site conditions, with two to four feet of rainwater accumulating annually in the shallow footprint of the former reservoir. When the pond exceeds capacity, the excess water overtops the lowest southwest section of bank and drains along the hillside. The pond typically remains wet from late fall through mid summer. Although this pond was not originally created for salamanders and frogs, it has become a secure breeding site for SCLTS with associated over-summering upland habitats.

In 1994, it was observed by the CDFG that rainwater spillover was gradually eroding the adjacent hillside, as well as potentially threatening the integrity of the earthen pond bank. A temporary fix of rip rap boulders was placed in the wash-out area to prevent further damage. During the El Nino winter of 1997–1998, substantially above-average rainfall caused a breach in the spillway section of earthen bank. The increase in water flow and velocity through the wash-out caused further scouring of the area.

In 2006, the Service permanently repaired the breach in the Calabasas Pond bank. This action was prescribed in the Revised Recovery Plan for the Santa Cruz long-toed salamander (USFWS 1999b). As part of the breach repair, the bank was replaced with a levee and fortified. A water control structure was installed in the new bank to manipulate water levels and to prevent erosion and bank failure from re-occurring during substantially above-average rainfall years.

3.2.3 Harkins Slough Unit

The dominant habitats found on the Harkins Slough Unit are former farmlands with approximately 51 acres of freshwater wetland, coastal grassland, San Andreas coastal live oak woodland, northern coastal shrub, and native and non-native herbaceous vegetation. The unit is bordered to the west and south by Harkins Slough Road, off of Buena Vista Drive. It is adjacent to the Buena Vista landfill, a plant nursery, a residential neighborhood, and a correctional facility along the western border. Agricultural fields and a former dairy are adjacent to the eastern border.

The Harkins Slough waterway itself continues upstream as a channel north of the unit and remains a large, open permanent freshwater wetland downstream to the south, beyond the flooded Harkins Slough Road. It is a natural drainage valley that flows to Watsonville Slough, which in turn flows into the Pajaro River before draining into the ocean.

The Refuge staff has observed large numbers of gulls using this unit for roosting, probably due to the proximity to a landfill. A variety of waterfowl species use the slough, including mallard, northern shoveler, cinnamon teal, and pintail. Flocks of white pelicans have also been observed feeding and roosting.

The unit contains several buildings, roads, wells, and utility infrastructure that are in disrepair. The buildings consist of three houses, a barn, warehouses, and storage and equipment sheds. There are three agricultural and two drinking water wells on the site.

Several parcels within the vicinity of this unit are owned by the California Department of Fish and Game or are in easements and protected from development. In 2009–2010, the Land Trust of

Harkins Slough Unit. Photo: USFWS

Santa Cruz County acquired approximately 486 acres southeast of the Harkins Slough Unit and is developing a management plan that includes slough restoration.

3.2.4 Buena Vista

The Buena Vista property is two miles west of the Watsonville Airport and 1.5 miles west of Watsonville. It is bound on the northeast by Highway 1, on the south by Fiesta Way and Rancho Road, and on the west by cultivated lands east of Willow Spring Road. It is a largely undisturbed micro-ecosystem consisting of a mosaic of San Andreas coastal live oak woodland, northern coastal shrub, San Andreas maritime chaparral, and Monterey pine woodland.

Buena Vista Pond is a small manmade ephemeral pond on the southeast portion of the site. Santa Cruz long-toed salamander and CTS have been found to breed at the site.

Several plants identified on the property are listed by the state as species of concern, including robust spineflower, Hooker's manzanita (*Arctostaphylos hookeri* ssp. *hookeri*), California bottlebrush (*Elymus californicus*), and Kellogg's horkelia (*Horkelia cuneata* ssp. *sericea*). Robust spineflower has been found on the Buena Vista property, however population estimates are not current.

A house and garage are located on Buena Vista; they were built in 1951, according to Santa Cruz County Assessor's records. A well is also associated with the property and is used to supply the residence with water.

3.3 Physical Resources

3.3.1 Climate and Air Quality

Santa Cruz County has warm summers and mild winters. Mean annual temperature in the county ranges from 54 to 58 degrees Fahrenheit. Near the coast, the difference between the mean daily minimum and maximum temperatures ranges from about 20 to 30 degrees (NRCS 2007a). In the coastal area where the Refuge is located, the mean daily temperature is about 50 to 55 degrees Fahrenheit minimum and 70 to 75 degrees Fahrenheit maximum. The mean daily temperature in January is about 35 to 40 degrees Fahrenheit minimum and 57 to 62 degrees Fahrenheit maximum. Mean

annual precipitation of about 30 inches is typical of the Santa Cruz area, and 20–25 inches is typical of the Watsonville area (NRCS 2007a).

Air quality is regulated by the Federal Clean Air Act (42 U.S.C. §§ 7401, as amended), which mandates the establishment of ambient air quality standards and requires areas that violate these standards to prepare and implement plans to achieve the standards by certain deadlines. Areas that do not meet Federal primary air quality standards are designated as "nonattainment" areas. Areas that comply with Federal air quality standards are designated as "attainment" areas. Attainment and nonattainment designations are pollutant specific. Agencies involved with air pollution management include the U.S. Environmental Protection Agency, California Air Resources Board, and the Monterey Bay Unified Air Pollution Control District. State and Federal governments have developed the following attainment standards for several criteria pollutants.

- Particulate matter less than 10 microns in diameter (PM10)
- Ozone
- Carbon monoxide (CO)
- Nitrogen dioxide (NO2)
- Sulfur dioxide (SO2)
- Sulfates
- Lead

The Refuge is located in the North Central Coast Air Basin. The pollutant measures for 2006 are as follows (CARB 2007).

Table 2. Pollutant measures for North Central Coast Air Basin - 2006

	State Standards	Federal Standards
Ozone	Nonattainment	Unclassified/attainment
PM10	Nonattainment	Unknown
CO	Attainment	Attainment
NO2	Attainment	Unclassified/ Attainment
SO2	Attainment	Unclassified
Sulfates	Attainment	n/a
Lead	Attainment	n/a

Source: CARB 2007

3.3.2 Climate Change and Greenhouse Gas Emissions

Global climate change is a problem caused by combined worldwide greenhouse gas (GHG) emissions, and mitigating global climate change will require worldwide solutions. GHGs play a critical role in the Earth's radiation budget by trapping infrared radiation emitted from the Earth's surface, which could have otherwise escaped to space. Prominent GHGs contributing to this process include water vapor, carbon dioxide ($C0_2$), nitrous oxide (N_20), methane (CR.), ozone, and certain hydro- and fluorocarbons. This phenomenon, known as the "greenhouse effect" keeps the Earth's atmosphere near the surface warmer than it would be otherwise and allows for successful habitation by humans and other forms of life. Increases in these gases lead to more absorption of radiation and warm the lower atmosphere further, thereby increasing evaporation rates and temperatures near the surface. Emissions of GHGs in excess of natural ambient concentrations are thought to be responsible for the enhancement of the greenhouse effect and to contribute to what is termed "global warming," a trend of unnatural warming of the Earth's natural climate. Climate change is a global problem, and GHGs are global pollutants, unlike criteria air pollutants (such as ozone precursors) and toxic air contaminants, which are pollutants of regional and local concern (USFWS, CDFG 2009a).

The Intergovernmental Panel on Climate Change (IPCC) has been established by the World Meteorological Organization and United Nations Environment Programme to assess scientific, technical and socio- economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. The IPCC predicts substantial increases in temperatures globally of between 1.1 to 6.4 degrees Celsius (depending on scenario) (Intergovernmental Panel on Climate Change 2007).

Climate change could impact the natural environment in California in the following ways, among others:

- Rising sea levels along the California coastline, particularly in San Francisco Bay and the Sacramento-San Joaquin Delta due to ocean expansion;

- Extreme-heat conditions, such as heat waves and very high temperatures, which could last longer and become more frequent;
- An increase in heat-related human deaths, infectious diseases and a higher risk of respiratory problems caused by deteriorating air quality;
- Reduced snow pack and stream flow in the Sierra Nevada mountains, affecting winter recreation and water supplies;
- Potential increase in the severity of winter storms, affecting peak stream flows and flooding;
- Changes in growing season conditions that could affect California agriculture, causing variations in crop quality and yield;
- Changes in distribution of plant and wildlife species due to changes in temperature, competition from colonizing species, changes in hydrologic cycles, changes in sea levels, and other climate-related effects.

For further discussion of climate change, refer to Appendix C – Environmental Assessment.

These changes in California's climate and ecosystems are occurring at a time when California's population is expected to increase from 34 million to 59 million by the year 2040 (California Energy Commission 2005).

As such, the number of people potentially affected by climate change as well as the amount of anthropogenic GHG emissions expected under a "business as usual" scenario are expected to increase. Similar changes as those noted above for California would also occur in other parts of the world with regional variations in resources affected and vulnerability to adverse effects.

GHG emissions in California are attributable to human activities associated with industrial manufacturing, utilities, transportation, residential, and agricultural sectors (California Energy Commission 2006) as well as natural processes.

United States Greenhouse Gas Emissions

In 2006, total U.S. GHG emissions were 7,054.2 million metric tons (MMT) CO_2 Eq. Overall, total U.S. emissions have risen by 14.7 percent from 1990 to 2006. The primary GHG emitted by human activities in the United States was CO_2, representing approximately 84.8 percent of total GHG emissions. The largest source of CO_2, and of overall GHG emissions, was fossil fuel combustion. CH_4, emissions, which have declined from 1990 levels, resulted primarily from enteric fermentation associated with domestic livestock, decomposition of wastes in landfills, and natural gas systems. Agricultural soil management and mobile source fossil fuel combustion were the major sources of N_2O emissions. The emissions of substitutes for ozone depleting substances and emissions of HFC-23 during the production of HCFC-22 were the primary contributors to aggregate HFC emissions. Electrical transmission and distribution systems accounted for most SF_6 emissions, while PFC emissions resulted from semiconductor manufacturing and as a by-product of primary aluminum production (U.S. Environmental Protection Agency 2008).

California Greenhouse Gas Emissions

Worldwide, California is the 12th to 16th largest emitter of CO_2 (California Energy Commission 2006), and is responsible for approximately 2 percent of the world's CO_2 emissions (California Energy Commission 2006).

Transportation is responsible for 41percent of the state's GHG emissions, followed by the industrial sector (23 percent), electricity generation (20 percent), agriculture and forestry (8 percent) and other sources (8 percent) (California Energy Commission 2006). Emissions of carbon dioxide and nitrous oxide are byproducts of fossil fuel combustion, among other sources. Methane, a highly potent GHG, results from off-gassing associated with agricultural practices and landfills, among other sources. Sinks[1] of carbon dioxide include uptake by vegetation and dissolution into the ocean. California GHG emissions in 2002 totaled approximately 491 MMT-CO_2 eq.

1 A carbon dioxide sink is a resource that absorbs carbon dioxide from the atmosphere. The classic example of a sink is a forest in which vegetation absorbs carbon dioxide and produces oxygen through photosynthesis.

3.3.3 Climate Change Regulation

Federal Climate Change Regulations

Twelve U.S. states (including California) and cities, in conjunction with several environmental organizations, sued to force the EPA to regulate GHGs as a pollutant pursuant to the Clean Air Act (*Massachusetts vs. Environmental Protection Agency et al.* [U.S. Supreme Court No. 05-1120]. Argued November 29, 2006. Decided April 2, 2007). The court ruled that the plaintiffs had standing to sue, that Clean Air Act does give EPA the authority to regulate tailpipe emissions of GHG, and the EPA is required to review its contention that it has discretion in regulating carbon dioxide and other GHG emissions. No regulations have been proposed by the EPA to date pursuant to this ruling.

In February 2002, President Bush committed the United States to a comprehensive strategy to reduce the GHG emission intensity of the American economy by 18 percent by 2012. In April 2008, President Bush announced a new national goal to stop the growth in U.S. GHG emissions by 2025. Although there is substantial work underway by the current administration of President Obama and new policies on GHG emissions are expected, no specific new policies on GHG emissions have been adopted as of March 2010.

Thus, at present, there are no Federal regulations specifically limiting the GHG emissions overall.

Department of the Interior Climate Change Requirements

Each bureau and office of the Department must consider and analyze potential climate change impacts when undertaking long-range planning exercises, setting priorities for scientific research and investigations, developing multi-year management plans, and making major decisions regarding potential use of resources under the Department's purview. These requirements were set forth in Secretary's Orders No. 3226 and 3285, and remain in effect. The organizational changes made by this Order will enable the bureaus and agencies to fulfill these planning requirements.

The Service's Climate Change Requirements

Increasing carbon dioxide and other greenhouse gas emissions from anthropogenic sources have altered the temperature over the last century more than any other time in history. Such temperature changes can have different consequences worldwide from sea-level rise to greater meteorological fluctuations. The Service recognizes that a changing climate will affect natural resources and has been charged by Congress (H. CON. RES. 2006) to address these effects in CCPs. This challenge is especially important at the Refuge in light of the sensitivity of amphibians to temperature fluctuations and narrow habitat ranges.

For further discussion of climate change, refer to Appendix C – Environmental Assessment.

Local Climate Change Regulations

The Monterey Bay Unified Air Pollution Control District (MBUAPCD) presently has no guidance concerning the California Environmental Quality Act (CEQA) evaluation of GHG emissions and no regulatory requirements.

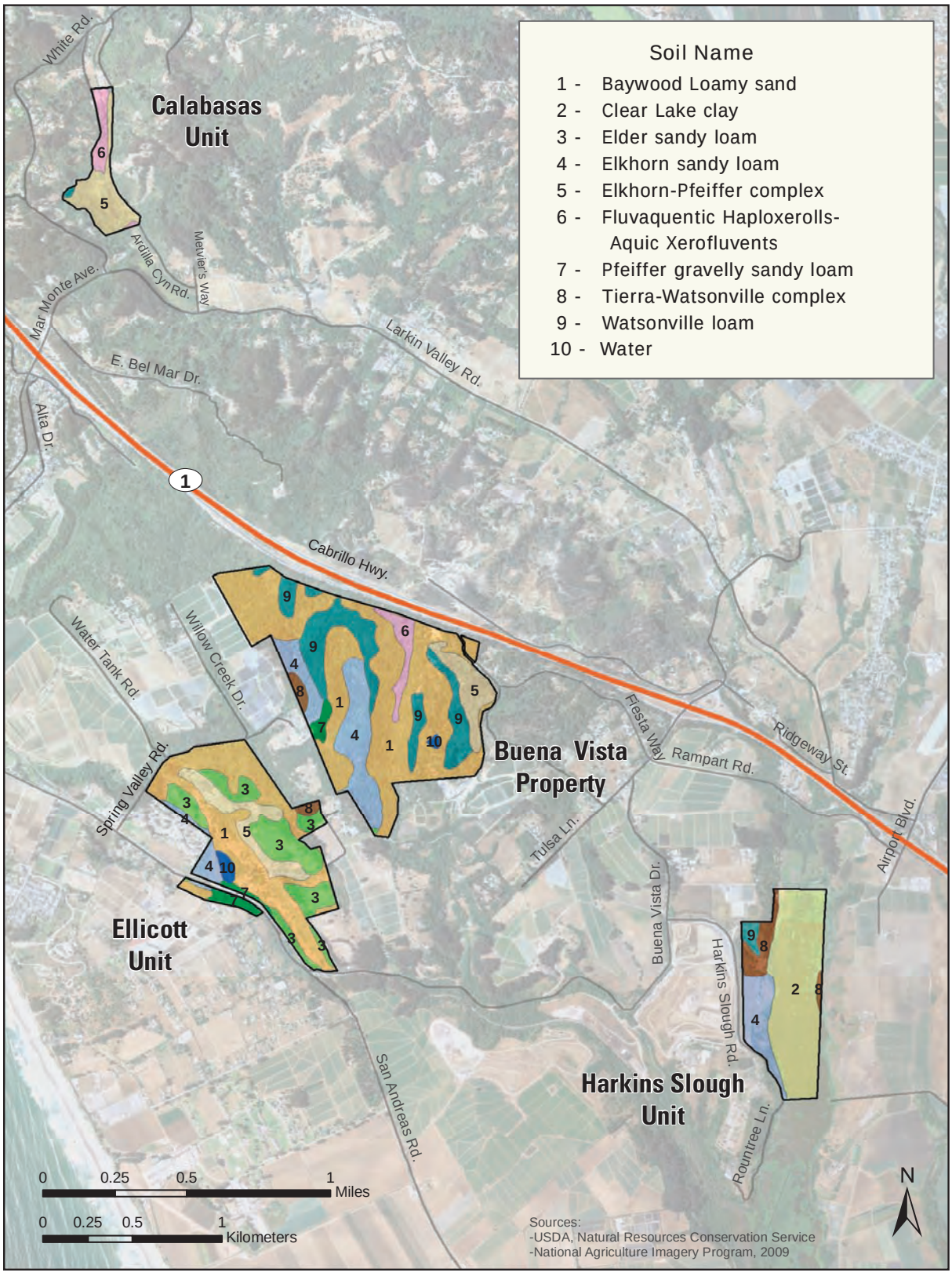
3.3.4 Topography

The topography of the Refuge units ranges from hilly to flat. The Refuge is closest to the city of Watsonville, which has elevation ranging from 20 to 900 feet. At the Ellicott Unit, elevation varies from 120 to 180 feet between the slough and the top of the adjoining hills. There are no permanent streams, and natural drainage systems are not well developed. The groundwater table is less than 150 feet below the surface. The Buena Vista property is surrounded by hilly, wooded terrain. The property slopes in elevation from 250 to 450 feet mean sea level. The land form includes three ridge lines and four drainage valleys extending in a north-south direction (Hanna and Associates 2001).

3.3.5 Geology, Soils, and Hydrology

The geology of the Refuge area is described as beach and dune sand (Quaternary). There are several soil types on the Refuge (see Figure 4). Baywood loamy sand is characteristically deep

Figure 4. Soil Types on the Ellicott Slough NWR



and drains somewhat excessively (NRCS 2007b). Sand dunes are made up of this soil type. Elder sandy loam is considered a well-drained soil and typically has a surface layer of dark grayish brown and grayish brown, medium acid and slightly acidic sandy loam about 23 inches thick. Elkhorn soils are well drained and are located on marine terraces and old alluvial fans. Typically, the surface layer is very dark grayish brown, slightly acid and medium acid sandy loam about 21 inches thick. The subsoil to a depth of 61 inches is pale brown and variegated light gray and very pale brown neutral sandy clay loam. Fluvaquentic Haploxerolls-Aquic Xerofluvents complex soils are considered moderately well drained, while the Tierra-Watsonville complex is considered moderately to poorly well-drained. Pfeiffer gravelly sandy loam is a deep, well-drained soil located on hills. It formed in material weathered from granitic rock, sandstone, or marine sediment. Watsonville loam consists of very deep, somewhat poorly drained soils on old coastal terraces. These soils formed in alluvium.

The geology of Buena Vista is relatively uniform and is mapped as Pleistocene non-marine Quaternary Aromas Formation. The soil at the Buena Vista property is described as sandy loam; the ridge soil tends to be shallow and finer textured. Soils in the lower lying positions tend to have argillic horizons (clay-enriched subsoils). Soils in the valleys vary from sandy to hydric. Buena Vista is a high-value groundwater recharge zone.

The Refuge is located within the Pajaro River Watershed. The Pajaro River Watershed is sourced by the Pajaro River and local runoff. Within the watershed, the Watsonville Slough System carries surface water through the different Refuge units. It is a remnant of a more extensive wetland and estuarine complex. The system has been modified to meet adjacent land use needs such as agriculture and urban development. The Watsonville Slough System currently is made up of six major branch sloughs as depicted in Figure 5. This 800-acre system is made up of coastal salt marsh, seasonal wetlands, brackish and freshwater emergent marsh, and riparian communities. The Watsonville Slough System also receives runoff from the 13,000-acre Pajaro River Watershed, which includes a mix of urban, industrial, rural residential, agricultural, and open space land uses (California Coastal Commission 2006). The Watsonville Slough System continues down a broad alluvial flood plain with irrigated agriculture as the primary land use and finally drains near a small residential dunes complex to the Pajaro Lagoon, joining the Monterey Bay and Pacific Ocean (Hager et al. 2004). However, flows have been observed in the reverse direction, from the mouth to the watershed. Factors of this phenomenon include high ocean waves, backwater flow from the neighboring Pajaro River, active pumping of the watershed, and land subsidence (Hager et al. 2004). The Refuge is sensitive to extreme flood events in the sloughs, with the Harkins Slough and Calabasas Units located within the Federal Emergency Management Agency floodplain.

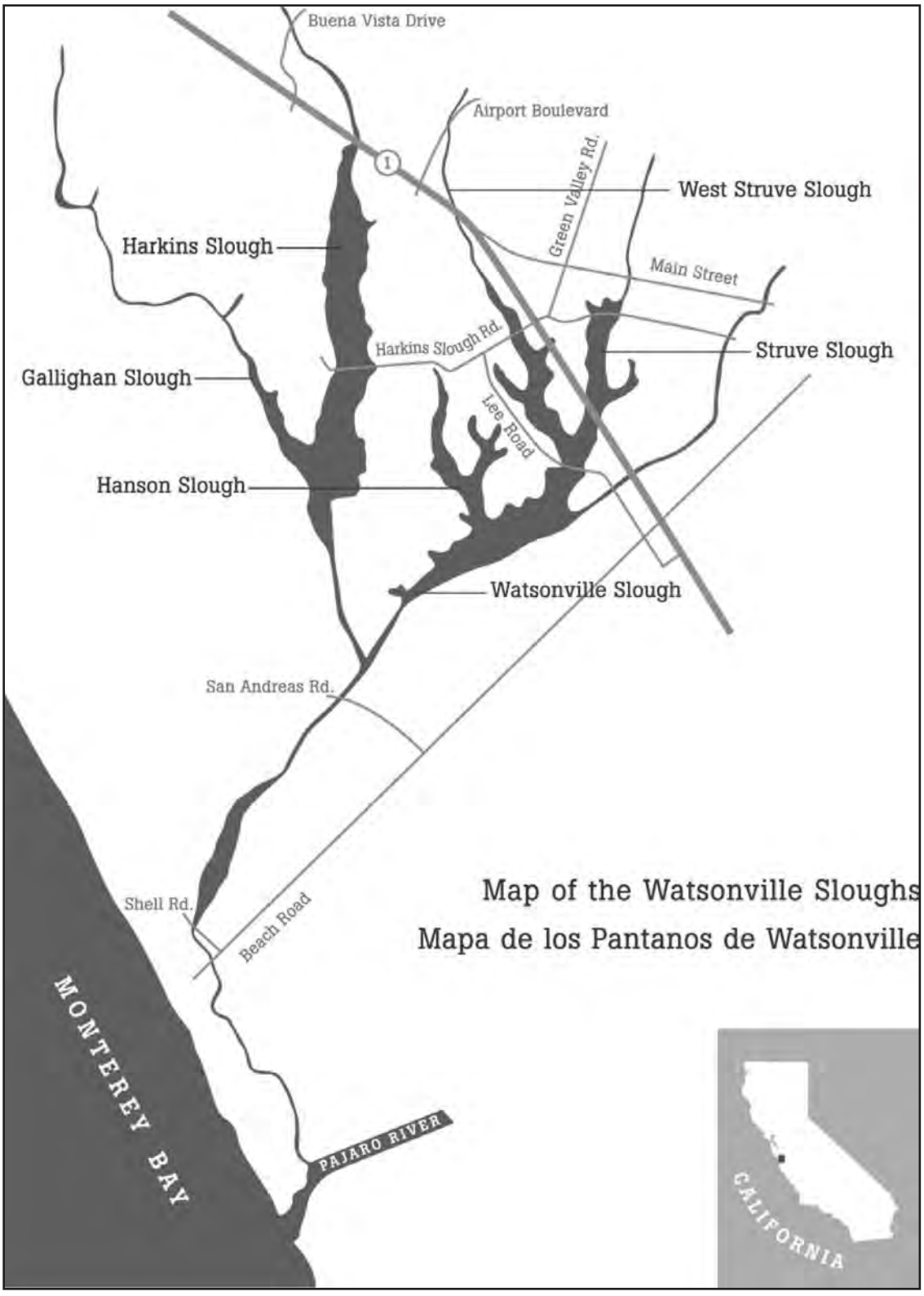
3.3.6 Water Supply and Water Quality

Santa Cruz County is one of the few California counties that are not dependent on water sources from outside its boundaries. However, increased water demand has exceeded currently developed surface sources and depleted groundwater supplies. Santa Cruz County primarily depends on surface flow and wells for its water supply, with some surface water inflow from San Benito County and some groundwater inflow from Monterey County (SCRCD 2008). The Refuge ephemeral ponds are heavily dependent on the rainfall captured in this slough system and watershed, as well as upland runoff.

Harkins Slough, part of the Watsonville Slough System (see Figure 5), is the largest and most northerly slough in the system. Its drainage initiates in Larkin Valley, flowing eastward under Highway One, between Airport Boulevard and Buena Vista Road. Near the county landfill, Harkins Slough broadens, flooding Harkins Slough Road year round. Below this point, the inaccessible Gallighan Slough merges with Harkins Slough. Continuing south, it merges into Watsonville Slough at the Pajaro Valley Water Management Pump Station off San Andreas Road, and then flows into the Pajaro River and finally into the Monterey Bay (Chirco-Mcdonald 2007).

Water quality on the Refuge is heavily influenced by agricultural practices in the surrounding region. Santa Cruz County is the second smallest county in California and the smallest agricultural county in California. Santa Cruz County ranked

Figure 5. Watsonville Slough System. Source: Watsonville Wetlands Watch (http://watsonvillewetlandswatch.org/images/sloughmapLarge.jpg)



20th out of 58 counties in value of agricultural production in 2005, with farm gate sales totaling $418 million (UCCE 2005). Watsonville Slough and the Pajaro River (downstream of Watsonville Slough) are both listed in the 2006 Federal Clean Water Act Section 303(d) as waterbodies that do not meet water quality objectives and do not support beneficial uses. The listing established a priority for developing a control plan to address the impairment of these waterbodies. Primary pollutants to the Watsonville Slough are pathogens from urban runoff and/or storm sewers, unknown sources, and nonpoint sources. Pesticides are also another stressor on the slough as a result of agriculture, irrigated crop production, agriculture storm runoff, agriculture irrigation tail water, and nonpoint sources (CCRWQCB 2006). Fecal coliform is another concern. Sampling by the Santa Cruz County Environmental Health Department (1977–2000) determined that 10 of 11 sites surveyed in the county exceeded the Central Coast Regional Water Quality Control Board's Basin Plan standards (Hager et al. 2004). A 2004 sampling of Watsonville Slough sites revealed that fecal coliform levels in the area compared closely with regional levels (Hager et al. 2004).

Other water quality information for the area is limited. No U.S. Geological Survey (USGS) survey sites were found in Santa Cruz County. The Coastal Watershed Council conducted a Clean Streams Citizen Monitoring Program of the Watsonville Slough System (in 2004) and the Harkins Slough Watershed (in 2007) using volunteer participation to gather surface water quality field data. The surveys found that the Watsonville Slough System has consistently high nitrate and bacteria, as well as low dissolved oxygen levels that often exceeded the water quality objectives based on the Basin Plan developed by the Central Coast Regional Water Quality Control Board (CCRWQCB) (Coastal Watershed Council 2004). The 2004 survey also found that *E. coli* and total coliform levels exceeded state water quality objectives at most of the survey stations. Nitrate and ammonia levels also exceeded acceptable CCRWQCB levels.

Although Harkins Slough is part of the Watsonville Slough System described above, the Harkins Slough surveys found low nutrient results, with orthophosphates and nitrate having the lowest number of exceedences based on unofficial Central Coast Ambient Monitoring Program (CCAMP) water quality objectives (Coastal Watershed Council 2007). Dissolved oxygen and pH levels were within acceptable ranges of the unofficial CCAMP water quality objective. However, the survey results found high levels of ammonia, E. coli, and total coliform in a majority of the samples. These high levels were thought to be attributed to large number of birds [gulls] frequenting the survey area and/or surrounding livestock fields. Total coliform count provides an indicator of pathogen conditions in the water. Testing for indicator bacteria monitors the potential presence of disease-causing organisms. Indicator bacteria are types of bacteria not normally found in high numbers in oceans, rivers, or creeks but always found in sources of fecal contamination. Though they are not typically disease-causing organisms themselves, they can be indicative of the presence of such organisms. Studies have shown that when concentrations of indicator bacteria exceed certain levels in waters used for water body contact recreation, individuals exposed to these waters may have a greater chance of getting sick (www.ccamp.org) (Coastal Watershed Council 2007).

Based upon results from the 2009 program and previous years, continued monitoring is a key factor in working towards watershed restoration. In addition, increased pressure from urban development and the region's intense commercial agriculture place significant strain upon the Watsonville Slough System, creating further need for study to move toward restoration of the watershed.

3.3.7 Hazardous Materials and Contaminants

A contaminant assessment process was conducted in May 1999 on the Ellicott Unit (USFWS 1999a). The report raised a number of concerns, including pesticide exposure from adjacent agricultural lands, application of methoprene to vernal breeding ponds, and the potential for an accidental spill of hazardous material or petroleum compounds from a train derailment. Since 2000, the Refuge has not permitted the use of methoprene by the Santa Cruz County Mosquito and Vector Control District in ponds used by SCLTS and CTS for breeding. As of 2010, the Refuge has stopped the use of methoprene by the Santa Cruz County Mosquito and Vector Control District, in ditches that fill seasonally with water, until

a mosquito management plan and environmental compliance are completed.

When the Calabasas Unit was acquired, the acquisition assessment noted no known uses or sources of hazardous materials on the property. In several areas, corroded, non-functional water pipes were identified. A Level I Environmental Site Assessment was conducted in 1998. Nearby above-ground storage tanks, electrical transmission lines, and non-functional water pipes were initially noted as potential hazardous materials (USFWS 1998). Upon further investigation, the storage tanks and water pipes were deemed innocuous.

Whether there are contaminants or hazardous materials present on the Buena Vista property is unknown; the property has not been surveyed.

During the acquisition assessment of the Harkins Slough Unit, Level I and II Pre-Acquisition Surveys identified several environmental concerns, including neighboring and on-site factors. Neighboring factors included impacts to groundwater and soil from the adjacent Buena Vista Landfill and nearby Western Farm Services, a former commercial fertilizer operation. There were a variety of discarded heavy equipment and several chemical storage containers, some of which were leaking. Concerns were noted that that the old containers and farming equipment contained contaminants that could runoff into the slough. The heavy equipment and containers were removed before acquisition.

Soil, surface water, groundwater, and drinking water well sampling was also conducted during the pre-acquisition surveys in 2004 (USFWS 2005b). Soil sampling analyzed for volatile organic compounds (VOCs), chlorinated pesticides and herbicides, some metals, and some nitrate sampling. Of 18 samples, only one sample exceeded project screening levels (USEPA Region IX Preliminary Remediation Goals-PRG). This sample detected methylene chloride, chlordane, chromium, and lead. Low concentrations of pesticides and methylene chloride were present on the unit. Low VOC levels were apparent but considered typical at this location. Arsenic was also found in a subsequent 2004 survey.

Table 3. Ellicott Slough NWR - Acreages of habitat types by unit

	Ellicott Unit	Calabasas Unit	Harkins Slough Unit	Buena Vista Property
Habitat Type	**Acres***	**Acres***	**Acres***	**Acres***
Acacia stands	0	0	0.2	6.2
Coastal grassland	24.5	5.6	13.8	3.4
Bare/developed/roads	2.7	0.4	0.5	1.2
Northern coastal shrub	41.4	12.6	6.2	51.9
Eucalyptus stands	5.3	0.0	0.0	13.2
San Andreas maritime chaparral	0.0	0.0	0.0	33.1
Closed-cone coniferous forest	19.8	0.0	0.0	21.1
San Andreas coastal live oak woodland	38.2	3.8	8.9	158.8
Ephemeral pond	3.7	1.9	0.0	0.4
Riparian woodland	24.7	6.8	5.2	0.1
Native and non-native herbs	7.0	0.0	6.5	0.0
Water	0.0	0.0	50.8	0.0
Freshwater marsh	0.0	0.0	16.7	0.0
Total Acres	167.3	31.1	108.8	289.4

**Habitat acreages are based on GIS analyses and satellite imagery with limited field sampling, and therefore are general estimates.*

Figure 6. Vegetation – Ellicott Unit

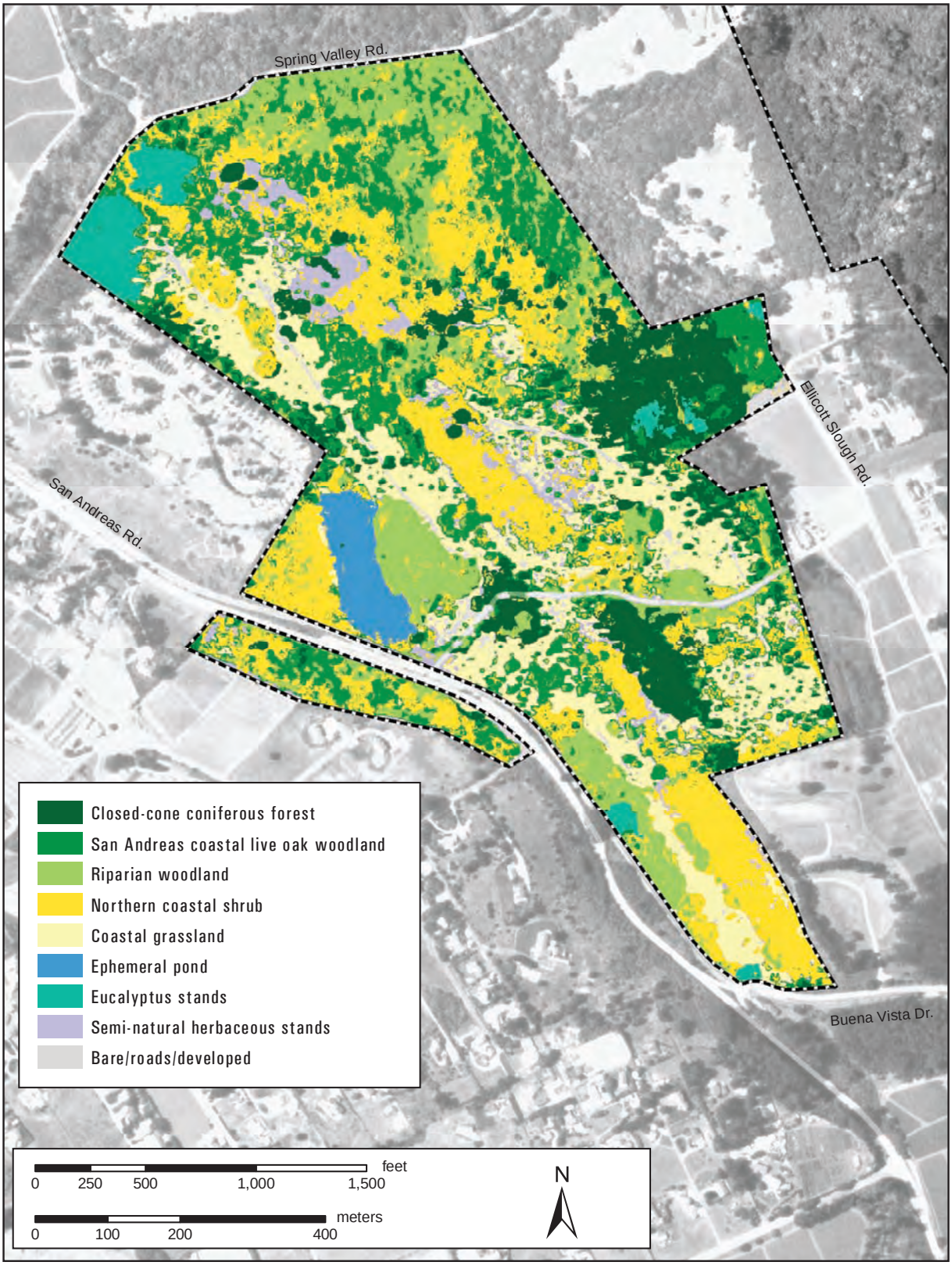


Figure 7. Vegetation – Calabasas Unit

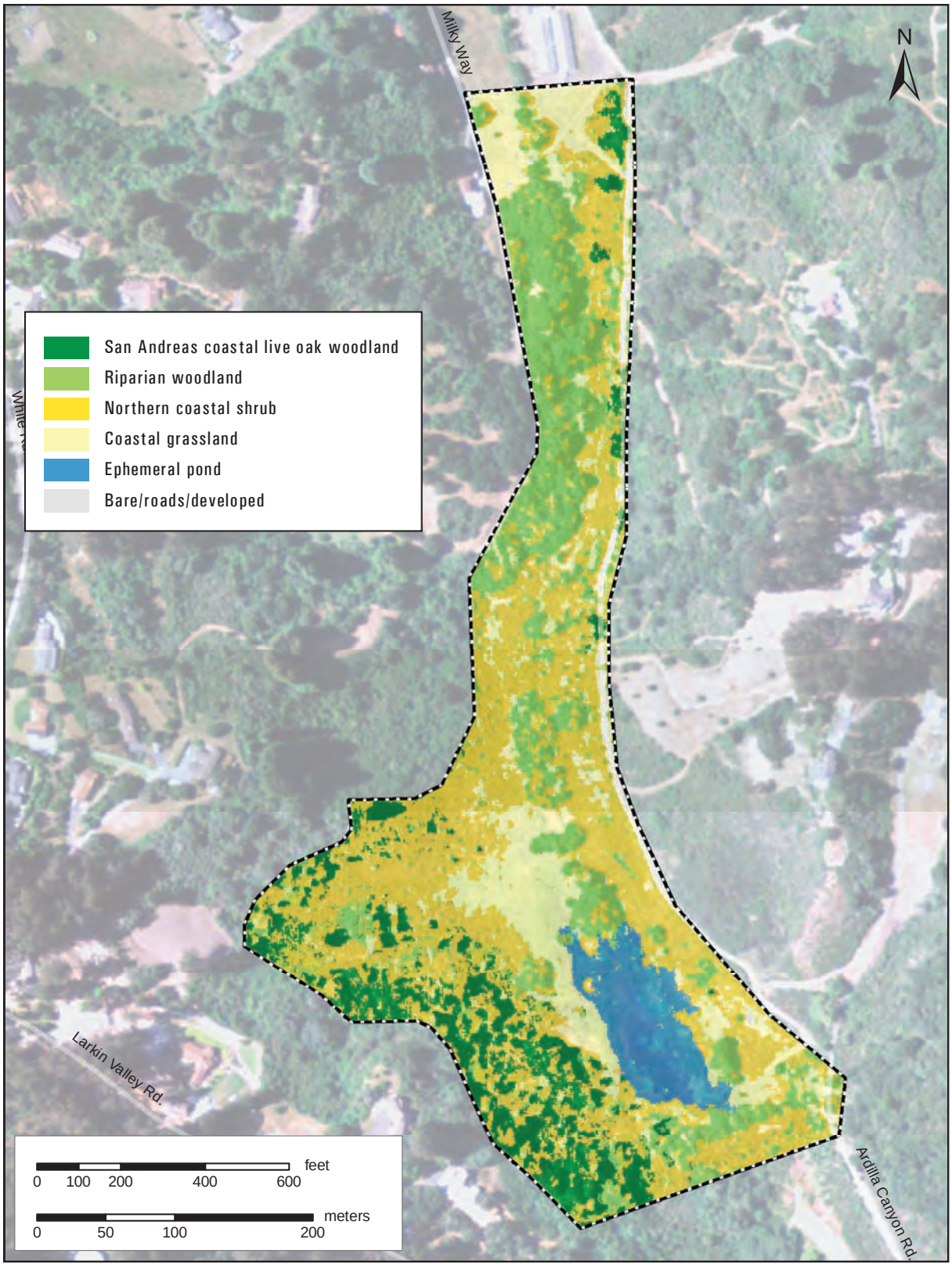


Figure 8. Vegetation – Harkins Slough Unit

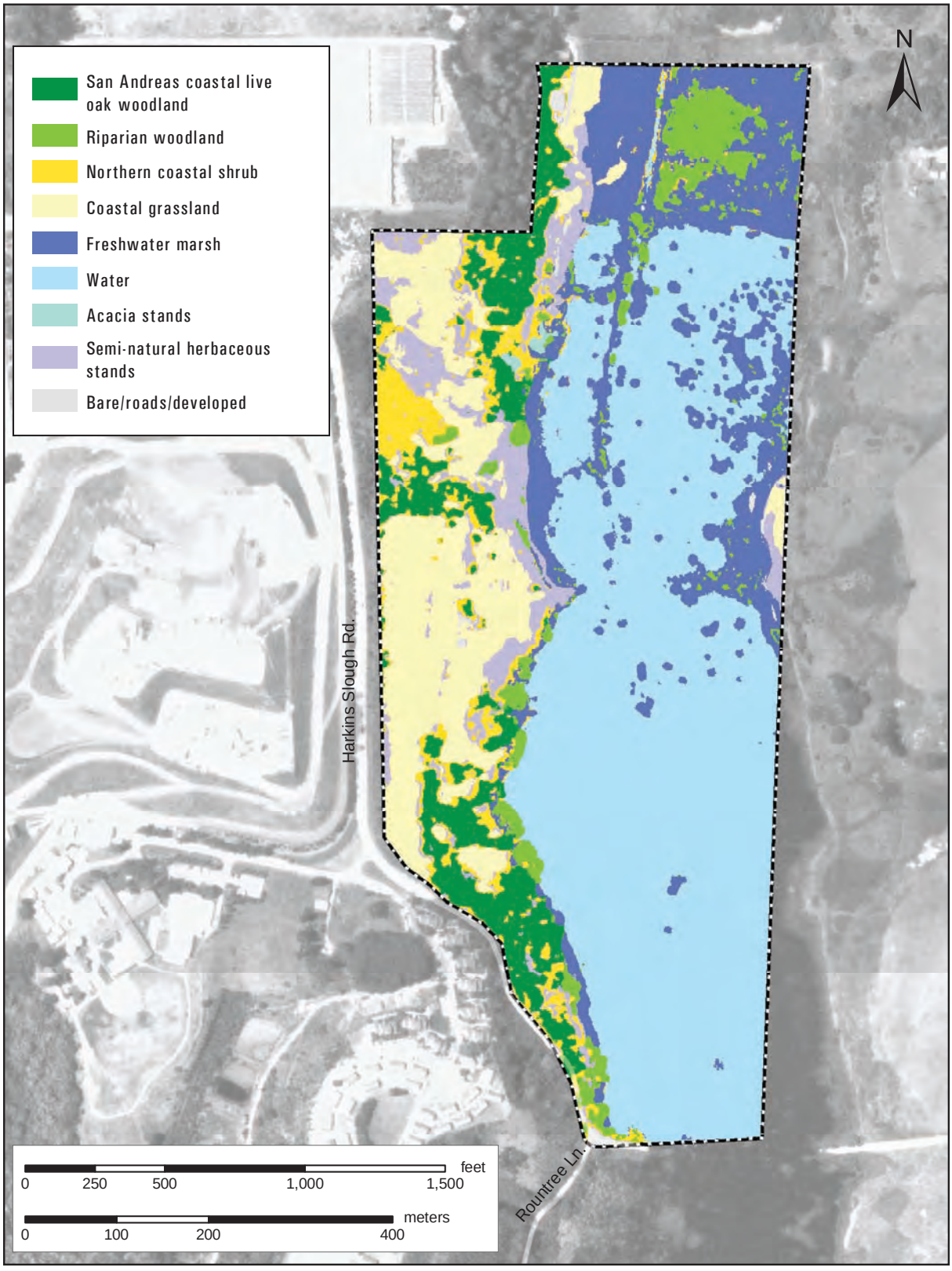
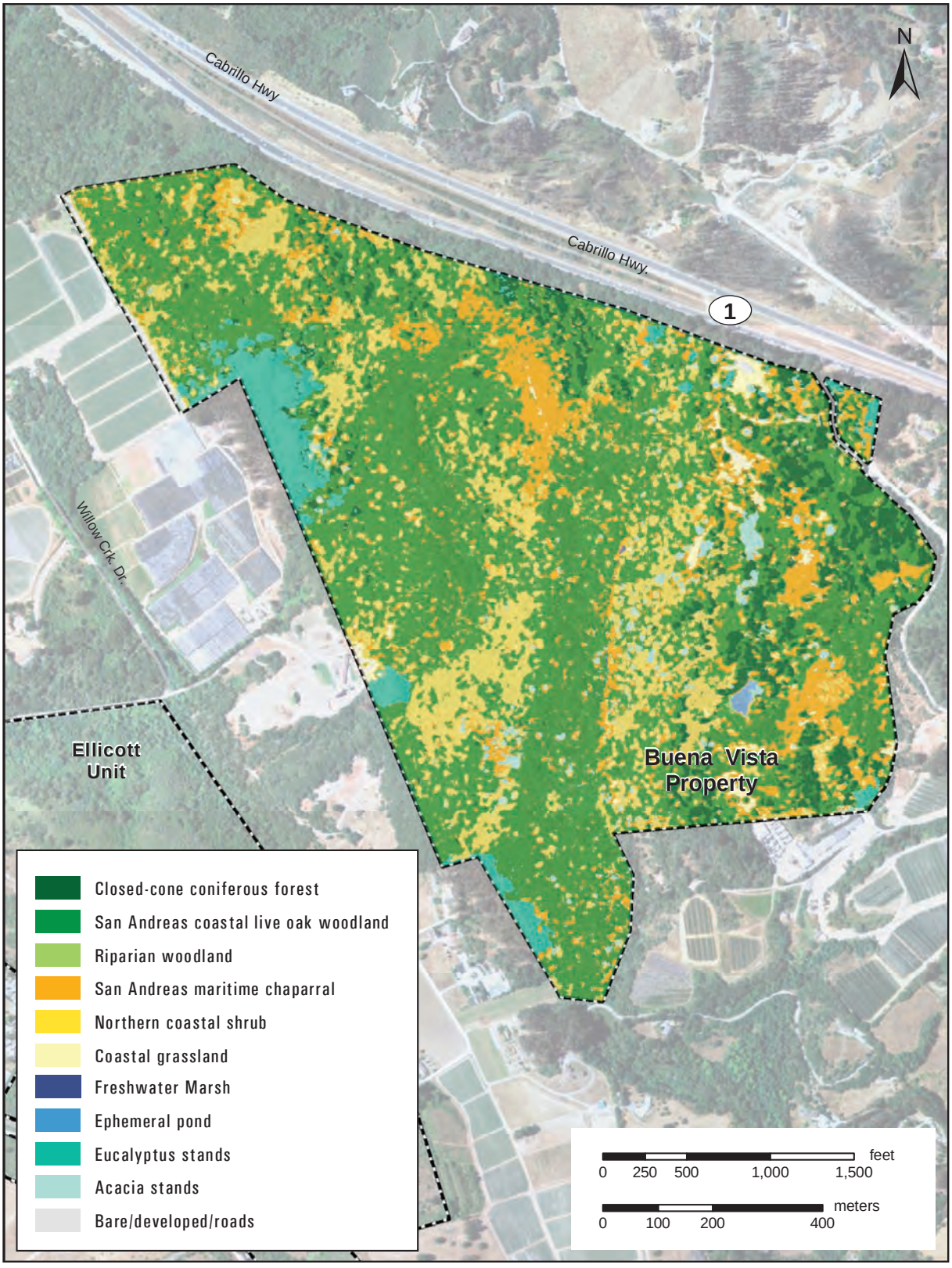


Figure 9. Vegetation – Buena Vista Property



Surface water sampling revealed lead concentrations that exceeded the maximum contaminant level (treatment action level of 15μg/l and the National Recommended Water Quality Criteria for Priority Toxic Pollutants criterion). Groundwater sampling showed that barium, chromium, lead, selenium, and nitrate concentrations exceeded project screening levels by a significant margin (USFWS 2005b). Drinking water well sampling tested positive for coliform bacteria and fecal coliform, indicating contamination from human or animal waste. Samples taken from buildings for lead and asbestos confirmed that lead was found in painted surfaces and asbestos in the building materials.

Prior to the transfer of the Harkins Slough Unit to the Refuge, the Farm Service Agency (FSA) required the former tenants to conduct a clean-up of the property. All chemical storage containers and the majority of the discarded farming equipment were removed from the site.

In 2006, follow-up water quality monitoring was conducted for lead in the Harkins Slough waterway. Results from the three surface water sample collected showed lead concentrations below detectable limits.

In 2006, special funding by the Amphibian Initiative of the U.S. Fish and Wildlife Service, Environmental Contaminants Program was made available to study amphibian abnormalities at the Ellicott and Calabasas Ponds. The study coordinators were especially interested in Ellicott Pond results, as Ellicott Pond was one of the first sites to document large numbers of abnormalities caused by trematode parasites in the mid 1980s. The survey found that the abnormal frog rates at Ellicott and Calabasas Units were consistent with the expected background abnormal rate of 2–3 percent in anuran populations (Stocum 2000). The Refuge received funding again in 2008 and 2009 for Calabasas Pond and found that sampled rates were above the expected rate both years (Tertes pers. comm.).

3.4 Biological Resources

3.4.1 Vegetation

Ellicott Slough NWR supports a variety of habitat types. The habitat types are described in the following sections. The habitat types on each of the Refuge units and the Buena Vista property are shown in the vegetation maps in Figures 6, 7, 8, and 9. A summary table of acreages of the various habitat types by unit is presented in Table 3. These acreages are based on Geographic Information System (GIS) analyses and satellite imagery with limited field sampling, and therefore are general estimates.

The Refuge has a wide variety of plant communities throughout its units. It has forests, woodlands, shrublands, grasslands, and freshwater wetlands, to name a few. Each habitat is important to maintain a complex relationship of plants, animals, and other organisms. The combination of habitats provides breeding and non-breeding areas for threatened and endangered amphibians, resident and migratory birds, mammals of varying sizes, and many other species. It also provides conditions suitable for endangered, rare, native, and invasive trees, shrubs, grasses, and forbs.

California's north coastal forests are divided into separate communities that integrate with one another. The largest and most important of these communities are the coastal redwood, Douglas fir, and mixed-evergreen forests. From the coast inland, species composition is dictated by moisture gradients. These gradients are determined by rainfall and the ability of soils to retain water. In moderately moist areas, farther inland, Douglas fir (*Pseudotsuga menziesii*) becomes dominant. Mixed-evergreen forests occur in warmer areas and are highly variable in their species composition (CERES 1997).

Ecologists recognize at least 13 major tree communities within California, and 5 of these are associated with the coastal regions. There are approximately 129 species of native trees in California, 63 of which are endemic. It is estimated that another 1,000 have been introduced from all over the world, but most of these are limited to private gardens. Nevertheless, about 30 to 50 introduced species have become naturalized, including the ubiquitous blue gum, *Eucalyptus globulus* (CERES 1997).

Closed-cone Coniferous Forests

Closed-cone coniferous forests are a unique California community occurring in patches along the coast from Humboldt to Santa Barbara County. The name of this community derives from the

fact that the seed-bearing cones remain closed for several years, a reproductive adaptation that ensures survival. Only age, excessive hot weather, or fire opens the cones (CERES 1997). Douglas fir, Monterey pine (*Pinus radiata*), and knobcone pine (*Pinus attenuata*) grow throughout the Refuge.

Coffeeberry. Photo: USFWS

San Andreas Coastal Live Oak Woodland

Coastal live oak woodland is characterized by hilly slopes with thin soils and moderate to large amounts of rainfall. The oak woodland present in Santa Cruz County is locally referred to as San Andreas Coastal Live Oak Woodland. It is considered a sensitive habitat by Santa Cruz County because of its high species diversity and relative scarcity (USFWS 2005a). Coast live oak (*Quercus agrifolia*) dominates this habitat; associated species include coffeeberry, madrone, California blackberry (*Rubus ursinus*), creeping snowberry, coyote bush (*Baccharis pilularis*), and poison oak (*Toxicodendron diversilobum*).

Riparian Woodlands

Riparian woodlands occur in ribbon-like bands along ephemeral creeks, ephemeral freshwater ponds, and canyon bottoms (USFWS 2005a) where there are rich soils and high humidity. Although this unique community accounts for less than one per cent of California's total forest acreage, it supports one of the most diverse ecological communities of plants and animals. Tall deciduous trees tower above a lush understory of ferns and delicate wildflowers. Unfortunately, many riparian woodlands have been destroyed during the last century because the fertile soils along rivers are among the most sought after for agricultural lands and because numerous rivers have been channelized for flood control projects (CERES 1997).

Below the canopy of trees, rich riparian soils support many species of ferns and willows such as the goldenback fern (*Pentagramma triangularis*), Arroyo willow (*Salix lasiolepsis*), and Sitka willow (*Salix sitchensis*). California blackberry and poison oak are frequently encountered shrubs in riparian communities.

Eucalyptus Stands

The invasive blue gum (*Eucalyptus* spp.) can be found in dense patches throughout the Refuge. Because of the large amount of leaves, bark, and other duff (and the tannins in them) that accumulate below each eucalyptus tree, there is little to no understory vegetation.

Acacia Stands

For the same reasons it is favored as an erosion-control plant, with its easy spreading and resilience, wattle (*Acacia* spp.) is an invasive species. Introduced worldwide, it has become an invasive plant that is taking over grasslands and the abandoned agricultural areas, especially in moderate coastal regions where mild climate propagates its spreading.

California's Coastal Plant Communities

Thirty percent of the state's native plant species are endemic to California. Common endemic plants include many species of manzanita and monkeyflower. Ecologists recognize as many as 80

different plant communities, constituting what is known as the California Floristic Province. Eleven of these communities, of which six are non-tree communities, are represented along the California coast (CERES 1997).

Coastal Grasses

Until late in the last century, the coastal prairie was almost entirely composed of native perennial grasses. These relatively slow-growing grasses have deep root systems and creeping stems that help to ensure their long-term survival; some individual plants are known to be more than 100 years old. Early European settlers found the naturally treeless coastal grasslands ideal for agriculture and ranching. As grazing operations expanded, fast-growing, invasive annual grasses were gradually introduced, and these began to out-compete the slow-growing, native perennials. Some introductions were accidental and others were intentional. Annual grasses live only a single growing season, but good seed dispersal ensures their return year after year. As a result, few intact native grassland communities remain today (CERES 1997).

Representative native coastal grasses include species of bentgrass (*Agrostis* spp.), hairgrass (*Deschampsia* spp.), and oatgrass (*Danathonia* spp.), which can all be found at Buena Vista. However, the majority of grasses found at the Refuge are invasive. Commonly encountered invasive grasses include wild oat (*Avena* spp.), fescue (*Vulpia* spp.), and brome (*Bromus* spp).

Ecologists believe that the presence of annual grasses has actually increased the number of wildflower species able to survive in this community (CERES 1997). Miniature lupine (*Lupinus bicolor)*, California buttercup (*Ranunculus californicus*), and the brilliant orange California poppy (*Eschscholzia californica*) are common inhabitants of the grassland community.

Coastal Scrub

Coastal scrub communities are characterized by low shrubs and an absence of trees. Types of shrubs include either pure stands or mixtures of low, thick-leaved evergreens and coarse, deciduous species that drop their leaves in response to periodic drought conditions. Three representative scrub assemblages (not strictly limited to the coast) are the northern coastal scrub, southern coastal sage scrub (or soft-chaparral), and arid hard-chaparral (CERES 1997).

Northern Coastal Scrub

The Refuge has northern coastal scrub throughout its units. Low, shrubby overstory and lush herbaceous undergrowth often characterize the northern coastal scrub community, which may graduate into adjacent coastal prairie. Many northern scrub species retain their leaves throughout the year. Native coyote brush is the most abundant plant in this community and is easily identified by its white fall flowers. California blackberry and poison oak are other common shrubs. The predominantly gray-green northern scrub landscape is accented by colorful sticky monkeyflower (*Mimulus aurantiacus*), deerweed (*Lotus scoparius*), and California lilac (*Ceanothus* spp.) (CERES 1997).

San Andreas Maritime Chaparral

The San Andreas maritime chaparral is considered a distinctive type of chaparral by Santa Cruz County because of its unique species composition (USFWS 2005a). The chaparral community is dominated by two species of manzanita: Hooker's manzanita, which is a rare species endemic to the Monterey Bay region of Santa Cruz and Monterey Counties, and wooly manzanita (Buena Vista Country Club, Inc. 1995). This vegetation type is considered highly restricted in distribution in California, with only 207 acres of San Andreas maritime chaparral remaining. Buena Vista includes approximately 33 acres of maritime chaparral.

Freshwater Marshes

Freshwater marsh plants have adapted to their aquatic environment in several ways. Most species have developed air tubes to their roots, buoyant leaves, or porous leaf coverings that enhance gas exchange. In contrast to salt marshes, freshwater marshes have little, if any, water movement (CERES 1997). Freshwater marshes can be found throughout the Refuge.

Typical freshwater marsh plants include numerous species of sedges; these grass-like plants often

exceed five feet in height. Sedge (*Carex* spp.) is one of the most common. Familiar cigar-shaped cattails (*Typha latifolia*) form thick stands and are so prolific that a single plant can rapidly fill a small pond. Bushy, needle-leaved rushes (*Juncus phaeocephalus*) and succulent water parsley (*Oenanthe sarmentosa*) are also typical freshwater marsh inhabitants (CERES 1997).

Freshwater marsh can be found surrounding a 50-acre permanent pond at the Harkins Slough Unit. The pond itself has only a few emergent plant species, such as willows and invasive water hyacinth (*Eichhornia* spp.).

Ephemeral Ponds

Seasonal freshwater ponds occur on Ellicott and Calabasas Units and on the Buena Vista property. The ponds tend to dry out during late summer. The amount and duration of water retention is a function of the amount and duration of rainfall during the year (Buena Vista County Club, Inc. 1995). Common plant species include native cattails, spikerush (*Eleochris* spp.), and invasive curly dock (*Rumex crispus*).

Semi-natural Herbaceous Stands

In addition to invasive tree stands such as eucalyptus and acacia mentioned previously, there are also many invasive herbaceous plants clumped in stands or occurring throughout most plant communities at the Refuge. Common species include poison hemlock, rosemary, mustard, Himalayan blackberry, and pampasgrass (*Cortaderia selloana*) and jubatagrass (*C. jubata*).

Threatened and Endangered Plant Species

Robust Spineflower

Robust spineflower was Federally-listed as endangered on February 4, 1994. It is currently known from 10 sites that support a total of 12 populations (USFWS 2004a). It is restricted to sandy soils along the coast and near-coastal areas in Santa Cruz and Marin Counties. It is a short-lived annual plant that germinates during the winter months and generally flowers from April through June. On the Refuge, it has been found on the Ellicott Unit (with an estimated 5 acres of standing plants) and at Buena Vista (10 acres). The species is not currently actively managed by Refuge staff.

The robust spineflower relies on sandy soils and coastal dune, coastal scrub, and grassland communities. Spineflower can grow in sunny openings within maritime chaparral and oak woodland communities; however, these two habitats themselves cannot support robust spineflower because of shade and leaf litter. Plants have been observed in disturbed areas along trails and where gopher disturbance is high (Baron, pers. comm.).

Populations of robust spineflower on Buena Vista have been followed for more than a decade. Available data are listed in Table 4 (CNDDB 1997, Baron, pers. comm.). On Buena Vista, approximately 135 acres of this critical habitat were designated for robust spineflower. The Ellicott Unit population trends are unknown.

Robust Spineflower. Photo: Sandra Baron

Table 4. Population counts for robust spineflower on Buena Vista

Year	Individuals Counted
1993	1,000
1997	1,000
2000	305
2003	3,700

3.4.2 Wildlife

Though the Watsonville Sloughs are a hydrologically compromised system (see Geology, Soils, and Hydrology in previous text), they are still biologically rich and highly valued. It is one of the largest remaining freshwater marshlands in the California coastal zone, providing critical habitat for numerous bird and plant species, including a variety of rare and endangered species. Located along the Pacific Flyway, it is an important rest stop, breeding ground and year-round habitat for over 200 species of waterfowl, songbirds, and raptors.

The many habitats of the Refuge provide homes for a variety of wildlife. Many species are present on the Refuge, including several amphibian, reptile, waterfowl, waterbird, raptor, songbird, mammal, invertebrate, and aquatic invertebrate species. The primary species that are actively surveyed are the Federally-listed amphibians. However, several surveys have been conducted to start a baseline account of birds and mammals. Incidental sightings have also proved fruitful in adding wildlife to the Refuge species list, such as medium and large mammals and reptiles. Though the Refuge is known for its amphibians, migratory birds use the Refuge for a stopover on the Pacific Flyway, as well as for roosting and nesting. Appendix F contains a list of wildlife species that occur or potentially occur at the Ellicott Slough NWR. An overview of wildlife use of the Refuge follows.

Federally-listed Wildlife Species at the Refuge

Three Federally-listed wildlife species occur on the Refuge: Santa Cruz long-toed salamander (SCLTS) (*Ambystoma macrodactylum croceum*), listed as endangered; the California tiger salamander (CTS) (*Ambystoma californiense*), listed as threatened; and the California red-legged frog (CRLF) (*Rana aurora draytonii*), listed as threatened. Habitat for these species range-wide is continually reduced due to development, resulting in fragmented areas, especially between salamander over-summering (upland) habitat and breeding grounds (pond). Furthermore, it is difficult to track productivity of these species because they spend most of their time over-summering underground and only migrate during rainy nights. In addition to conducting night time surveys in the winter, surveys are also conducted in late spring to determine if reproduction has occurred. These larval surveys are conducted for presence or absence, health, and fitness.

Table 5. Santa Cruz long-toed salamander subpopulation complexes

Santa Cruz metapopulation	
Valencia-Seascape	Valencia Lagoon and Seascape Ponds and surrounding upland habitat
Larkins Valley	Calabasas, Suess, and Olive's Ponds and surrounding upland habitat
Ellicott-Buena Vista	Ellicott, Buena Vista, Ranch Road, Green's and Anderson's Ponds and surrounding upland habitat
Freedom	Palmer, Racehorse, Tucker, Merk, and Millsap Ponds and surrounding upland habitat
Monterey metapopulation	
McClusky	Zmudowski Pond, Bennett Slough/Struve Pond, McCluskey Slough and surrounding habitat
Elkhorn	Oxbow Pond, Lower Cattail Swale, Northern Moro Cojo and Southern Moro Cojo Sloughs and surrounding upland habitat

Source: Santa Cruz Long-toed Salamander 5-Year Review (USFWS 2009)

Santa Cruz long-toed salamander larvae. Photo: USFWS

Adult Santa Cruz long-toed salamander. Photo: Leah Oscar

Santa Cruz Long-toed Salamander

SCLTS was among the first animals listed as endangered by the Service in 1967 due to several factors, most prominently habitat loss and fragmentation. At the time, only two breeding localities of the species, Valencia Lagoon and Ellicott Slough, were known. The presence of the SCLTS has been documented at only 24 locations in southern Santa Cruz County and northern Monterey County. Breeding has been documented at 19 of the 24 known locations since the last revised recovery plan for the subspecies (USFWS 1999b) was published. The subspecies likely has been extirpated from two locations: Bennett Slough/ Struve Pond in Monterey County and Rancho Road Pond in Santa Cruz County. It is not known whether two other previously known breeding locations (Green's Pond and Anderson's Pond) in Santa Cruz County still exist. Additionally, breeding has not been documented at Lower Moro Cojo Slough (in Monterey County) since 1990 (USFWS 2009). This species was added to California's endangered species list in 1971, with additional protections under the Santa Cruz Local Coastal Plan and the Santa Cruz County Salamander Protection District zoning regulations.

SCLTS are found in six metapopulations, four of which are located in Santa Cruz County and two of which are located in Monterey County. Each metapopulation contains one or more subpopulations. Metapopulations found in Santa Cruz County include Valencia-Seascape, Freedom, Larkin Valley, and Ellicott-Buena Vista while metapopulations found in Monterey County include McCluskey and Elkhorn (see Table 5). The Ellicott Unit, Harkins Slough Unit, and Buena Vista property are located within the Ellicott-Buena Vista metapopulation and the Calabasas Unit of the Refuge is located within the Larkin Valley metapopulation (USFWS 2009). There is no single comprehensive population estimate available, and only sporadic surveys have been conducted on some parts of some subpopulations. For the purposes of this CCP, data and management of only the Larkins Valley and Ellicott-Buena Vista complexes will be discussed. The Refuge provides both breeding (ponds) and over-summering (upland) habitat for SCLTS.

The Larkins Valley complex lies in the upper Harkins Slough watershed. The Refuge's Calabasas Pond is located in the Larkins Valley complex and is considered a breeding site. The current size and status of this salamander subpopulation is unknown, but surveys have documented reproduction in 1989, 1993, 1995, and 2004–2010 (USFWS 1999b, Tertes pers. comm. 2010).

SCLTS rely on freshwater ponds for egg development, where larvae feed and grow in the pond for three to seven months before becoming terrestrial. Insufficient precipitation, unusually cold weather, parasites, or other unknown factors may severely limit recruitment. Adults may go several years without successfully breeding. SCLTS

apparently are long-lived creatures, possibly living for a decade or more (USFWS 2009).

The primary terrestrial habitats for SCLTS are oak woodland, woody riparian, and moist coastal scrub vegetation types. SCLTS spend the majority of their life in these terrestrial habitats, underground in small mammal burrows and among the root systems of plants in upland chaparral and woodland areas of coast live oak or Monterey pine, as well as in riparian strips of arroyo willows. These areas are desirable because they are protected from heat and the drying rays of the sun. From November to February, their annual nocturnal migration to the breeding ponds occurs. The breeding ponds are usually shallow and ephemeral freshwater ponds; however, most ponds currently known to be used for breeding are artificial. The extent of the upland habitat potentially used by SCLTS varies from a ring of riparian vegetation on the perimeter of the pond to as far as one mile or more out from the pond. However, examination of all currently available studies on SCLTS reveals that no adults have been observed to move more than 0.6 mile (straight line distance) from a breeding site where they were originally marked. The distance between known breeding and over-summering locations varies greatly from site to site and apparently depends largely upon soil type, vegetation presence or absence, vegetation structure or composition, and slope, aspect, and size of the breeding pond (USFWS 2009).

The Ellicott Slough-Buena Vista complex contains five ponds that have been used as breeding habitat by SCLTS. Breeding activity has been documented at the other sites in the vicinity since 1993. The Ellicott Pond population was surveyed from 1956–1960, and it was estimated that there were 8,000–10,000 individuals (USFWS 1999b). A population estimate was also conducted during 1972–1973, yielding an estimated 6,000–8,000 individuals (Marlow 1973). A survey from 1979–1980 indicated that Ellicott Pond was used for breeding. Approximately 345 adults were found migrating to the pond for the breeding season (Reed 1979). Juveniles were also seen moving away from the pond, indicating successful recruitment. Since then, regular monitoring has documented the presence of salamanders in most years between 1992 and 2010 (USFWS 1999b, Tertes pers. comm. 2010). Survival of the Ellicott population was threatened in 1970 when the owner of the breeding site and much of the upland attempted to rezone the area for a trailer park (Bury and Ruth 1972).

The Buena Vista Pond was created during the 1940s, and SCLTS were first found here in 1992. It may support several hundred adults, based on trapping studies conducted during 1995 (Jennings 1995). An additional mark-recapture study was conducted by Biosearch Associates in the winter of 2008–2009. They estimated the breeding adult population of SCLTS at Buena Vista Pond to be 775, with a 95 percent confidence interval of ± 380 due to low number of recaptures. However, due to a shortage of rainfall and therefore a shortened hydro-period, breeding migration was affected and the population size has probably been underestimated (Biosearch Associates 2009). The hydro-period is the duration of time an ephemeral pond will retain water.

The SCLTS continues to face numerous threats, including loss and degradation of both upland and breeding habitats from proposed residential development, road kill, encroachment of agricultural activities and invasive plant and animal species, sedimentation, and degraded water quality. Disjunct distributions have made SCLTS especially susceptible to population declines resulting from human-associated factors such as habitat loss. Degradation and destruction of aquatic breeding habitat was the primary reason for listing this species. In Santa Cruz County, the primary threats have been road construction and urbanization. Other threats include predators such as invasive opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), and a variety of snakes. Further details of life history and biology of the SCLTS are contained in the revised Recovery Plan (USFWS 1999b). Although the SCLTS is now known from more locations than when it was listed and some sites are now protected, the overall status of the SCLTS remains tenuous.

California Tiger Salamander

The CTS, listed as threatened in August 2004, inhabits large ephemeral pools and their surrounding grasslands throughout the Central Valley as well as adjacent foothill and coastal grasslands. It is the only native tiger salamander species known to occur in its range. It is estimated

California tiger salamander juvenile. Photo: Heather Butler

that 75 percent of the original CTS habitat is now lost due to anthropogenic impacts and that 55 to 58 percent of documented historic breeding sites has been eliminated (USFWS 2004).

The CTS life history is similar to the SCLTS, requiring shallow ephemeral ponds for breeding in the winter months. During the summer months, CTS persist in open grasslands, using ground squirrel and pocket gopher burrows, as well as deep cracks or holes in the ground, for over-summering. CTS have been demonstrated to remain active throughout the summer, moving small distances within burrow systems. Dispersal distances from pond breeding sites to upland burrows depend on local topography and vegetation, distribution of burrows, and climatic conditions. CTS require different over-summering habitat from the SCLTS. CTS prefer grassland, whereas Santa Cruz long-toed salamanders prefer oak woodland.

Both breeding and over-summering habitat for CTS are provided at the Ellicott Unit and the Buena Vista property. Regular monitoring has documented the presence of salamanders in most years between 1993 and 2010 at Ellicott Pond (Tertes pers. comm. 2010). However, breeding and non-breeding habitat use has not been thoroughly assessed at the Refuge. In the winter of 2008–2009, two adult female and 11 adult male CTS were captured at the Buena Vista Pond during a mark-recapture study performed by Biosearch Associates. Biosearch estimated the breeding adult population of CTS at Buena Vista Pond to be 16, with a 95 percent confidence interval of ± 10. However, due to a shortage of rainfall and therefore a shortened hydro-period, breeding migration was affected, and the population size has probably been underestimated (Biosearch Associates 2009). During the study, Biosearch also sent CTS tissue for genetic testing. Results verified the salamander as the native CTS—and not a hybrid. (Biosearch Associates 2009). There have been no CTS population studies conducted at Ellicott Pond; however, CTS have been found during rainy night-time surveys at Ellicott Unit (Tertes, pers. comm. 2010). Therefore, while the Ellicott Unit and Buena Vista have breeding CTS, there is currently no population estimate.

California Red-legged Frog

The CRLF was listed as a threatened species on June 24, 1996. It is also listed as a state species of concern. The CRLF has been extirpated or nearly extinct from 70 percent of its former range. Habitat loss and alteration, combined with over-exploitation and introduction of invasive predators, were important factors in the decline of the CRLF in the early to mid-1990s. Primary threats that led to its listing status included urban encroachment, construction of reservoirs and water diversions, contaminants, agriculture, and livestock grazing (USFWS 2002). At present, CRLF are known to be present in approximately 256 streams or drainages from 28 counties, primarily in central coastal California (USFWS 2002).

CRLFs breed from November through April. California red-legged frogs spend most of their lives in and near sheltered backwaters of ponds, marshes, springs, streams, and reservoirs. Deep pools with dense stands of overhanging willows and an intermixed fringe of cattails are considered optimal habitat. California red-legged frog eggs, larvae, transformed juveniles, and adults also have been found in ephemeral creeks and drainages and in artificial ponds devoid of riparian or wetland vegetation. Each of the life stages also have been observed in artificial environments, such as stock ponds, sewage treatment ponds, irrigation ponds, wells, canals, golf course ponds, sand and gravel pits, and large reservoirs (USFWS 2002).

Accessibility to sheltering habitat is essential for the survival of CRLF within a watershed and may be a factor limiting population numbers and distribution. Juvenile and adult CRLF have been observed in areas of riparian vegetation where they may use small mammal burrows, moist litter, and debris such as discarded lumber (boards on the ground)

for sheltering. During wet periods (particularly winter and spring), CRLF may move long distances between aquatic habitats, often traveling through habitats previously considered to be unsuitable for frogs. California red-legged frogs have been found more than one mile from breeding habitat and may reach isolated aquatic habitats up to a mile away from the nearest known CRLF populations (USFWS 2002).

The Refuge falls into one of the recovery units for this species. Critical habitat has also been designated at Ellicott and Harkins Slough Units and the Buena Vista Property (USFWS 2010). However, breeding and non-breeding habitat use by the CRLF has never been thoroughly assessed at the Refuge. Therefore, the current status and size of the population at the Refuge is unknown. There have been anecdotal reports that CRLF have been heard calling at pond at the Ellicott Unit; however, no larvae have been found in the pond. Pond surveys at the Calabasas Unit indicated presence of California red-legged frog larvae once in the past 10 years. Ongoing threats, which are primarily the result of urbanization and agricultural activities, include habitat loss, fragmentation, and degradation and establishment of invasive vegetation, disease, and predators.

Other Wildlife

Amphibians and Reptiles

In addition to the special status amphibians, a variety of other native amphibian species have been found on the Refuge, including California slender salamander (*Batrachoseps attenuatus*) and arboreal salamander (*Aneides lugubris*). Pacific tree frogs are most commonly seen in or adjacent to seasonal and permanent waterbodies, while other amphibians are more commonly seen during terrestrial night-time surveys. Some species found during these surveys include ensatina salamander (*Ensatina eschscholtzii*), arboreal salamander, California slender salamander, and Pacific tree frog (see Appendix F).

Reptiles are common residents in the upland, riparian, and wetland habitats. Reptile species recorded during coverboard surveys include western fence lizard (*Sceloporus occidentalis*), southern alligator lizard (*Elgaria multicarinata*), and western skink (*Eumeces skiltonianus*). Additional sightings by Refuge personnel during tree removal work, plantings, and surveys include ringneck snake (*Diadophis punctata*), racer (*Coluber constricta*), gopher snake (*Pituophis melanoleuca*), common garter snake (*Thamnophis sirtalis*), and Western terrestrial garter snake (*Thamnophis elegans*). A list of wildlife species is included in Appendix F.

Mammals

Many mammalian species are year-round residents of the Refuge. A small mammal trapping study in 1977 by CDFG was the first inventory of mammal species on the Refuge. Small mammals, in particular, are important to inventory, as the SCLTS and CTS use small mammal burrows to over-summer in during the summer months. Species captured during the study included California mouse (*Peromyscus californicus*), deer mouse (*Peromyscus maniculatus*), Piñion mouse (*Peromyscus truei*), dusky-footed woodrat (*Neotoma fuscipes*), and California meadow vole (*Microtus californicus*). Since the initial study, Botta's pocket gopher (*Thomomys bottae*) and California ground squirrel (*Spermophilus beecheyi*) have also been observed on the Refuge and identified as important burrow contributors. Additional mammals include brush rabbit (*Sylvilagus bachmani*), common muskrat (*Ondatra zibethicus*), mountain lion (*Felis concolor*), bobcat (*Felis rufus*), coyote (*Canis latrans*), feral pig (*Sus scrofa*), and mule deer (*Odocoileus hemionus columbianus*). See Appendix F for a complete list.

Birds

The Refuge provides a variety of habitats for a great diversity of migratory and resident birds. Appendix F provides a list of the birds species observed on the Refuge. In 1998, Higley conducted single-day, four-season bird surveys at the Ellicott Unit, establishing the Refuge bird list (unpublished data). Bird walks led by the Santa Cruz Bird Club on the Harkins Slough Unit from 2008 to present day and ongoing incidental observations by Refuge personnel have added to the species list.

Migratory and resident landbirds can be found throughout the Refuge. Birds visit the Refuge to breed, forage, and roost. Some common birds seen include scrub jay (*Aphelocoma coerulescens*), Anna's hummingbird (*Calypte anna*), Northern

mockingbird (*Mimus polyglottos*), rock dove (*Columba livia*), American robins (*Turdus migratorius*), Northern flicker (*Colaptes auratus*), and barn swallows (*Hirundo rustica*). Cedar waxwings (*Bombycilla cedrorum*) and white-crowned sparrows (*Zonotrichia leucophrys*) are just two of the many landbird species that use the Refuge during migration.

Many wading and diving birds use Harkins Slough Unit year round, utilizing the Slough and adjacent riparian habitats for foraging, roosting, and occasionally nesting. Great blue heron (*Ardea herodias*), great egret (*Ardea alba*), snowy egrets (*Egretta thula*) and double-crested cormorants (*Phalacrocorax auritus*) are seen year round. Other waterbirds use the Refuge at various times throughout the year, such as American bitterns (*Botaurus lentiginosus*), American coots (*Fulica americana*), and American white pelicans (*Pelecanus erythrorhynchos*).

Many species of raptors (birds of prey) are found among the various habitats of the Refuge. Red-tailed hawks (*Buteo jamaicensis*) are the most commonly seen raptor at the Refuge; however, white-tailed kites (*Elanus coeruleus*) and American kestrels (*Falco sparverius*) are also common. Osprey (*Pandion haliaetus*) and red-tailed hawks (*Buteo jamaicensis*) are just two of the raptors known to nest at the Refuge.

California quail (*Callipepla californica*) are common residents in the oak woodland scrub found at the Refuge. Several species of gulls can be found foraging or roosting in Harkins Slough. Many of these gulls are supported by the adjacent landfill.

Fish

The Harkins Slough Unit currently provides the Refuge's only permanent, freshwater habitat suitable for fish. A one-time dip-net survey in 2006 identified prickly sculpin (*Cottus asper*) and invasive carp. In addition, a CDFG warden reported that hardhead (*Arius felis*), bullhead catfish (*Ameiurus* sp.), and Sacramento blackfish (*Orthodon microlepidotus*) were illegally fished at Harkins Slough Unit (Schindler, pers. comm. 2010); Harkins Slough is closed to the public. It is unknown if other fish persist at Harkins Slough Unit.

Invertebrates

Invertebrate populations are greatest and most diverse in aquatic habitats and provide an important food base for many fish and wildlife species (e.g., salamanders), both aquatic and terrestrial. Common aquatic invertebrates include water fleas (family: *Daphniidae*), snails (e.g., planorbid (*Planorbella tenuis*)), clam shrimp (order: Conchostraca), fairy shrimp (family: *Artemidae*), dragonflies and damselflies (order: Odonata), waterboatmen (family: *Corixidae*), backswimmers (family: *Notonectidae*), beetles (order: Coleoptera), midges (order: Diptera), mosquitoes (family: *Culicidae*), and worms. Terrestrial invertebrates are an important food base for many migratory and resident bird species, as well as for reptiles, amphibians, and small mammals. Common species include ants (family: *Formicidae*), butterflies (order: Lepidoptera), beetles (order Coleoptera), grasshoppers (order: Orthoptera), ticks (family: *Ixodidae*), bees and wasps (order: Hymenoptera), and moths (order: Lepidoptera).

Biotic Threats to Amphibians

Amphibians face many threats to survival such as disease, predators, and trematodes. Chytrid fungus (*Batrachochytrium dendrobatidis*) (BD) causes chytridiomycosis, a disease that is potentially lethal to most amphibians. The fungus attacks the keratinous areas, such as mouth parts in tadpoles and hands and feet in adult frogs (Hossack et al 2010). BD infection outcomes, such as increased sloughing, discolored skin and mouth parts, and mortality are species specific (Padgett-Flohr 2008).

Several observations of chytrid fungus infections (BD) were recorded on the Refuge over the last decade. During a dip-net survey in Calabasas Pond in May 2005, a large number of tree frog tadpoles, a few California red-legged frog tadpoles and several Santa Cruz long-toed salamander larvae were found to be emaciated and in poor condition. One salamander larvae and one California red-legged frog tadpole were sent to the USGS National Health Center (Health Center) to be analyzed. Chytrid fungus was confirmed in both specimens. The most recent finding of chytrid fungus occurred in May 2006 at the Harkins Slough Unit. A bullfrog specimen was sent to the Health Center and resulted in a positive confirmation for

the presence of chytrid fungus on the Harkins Slough Unit.

Santa Cruz long-toed salamanders, California tiger salamanders, and California red-legged frogs are vulnerable to several predators throughout their home range, such as crayfish, bullfrogs (*Rana catesbeiana*), fish, birds, garter snakes (*Thamnophis* sp.), aquatic insects, raccoons (*Procyon lotor*) and even adult salamanders. These predators can eat amphibian eggs, larvae, and adult salamanders, making them a threat to special status and native salamanders and frogs (USFWS 2009).

While no Refuge surveys have been conducted for invasive wildlife, various species have been identified throughout the years. Native predators on the Refuge include animals such as garter snakes, opossums, great egrets, and raccoons. Crayfish, bullfrogs, and carp are a few of the invasive species that have been observed on the Refuge. Crayfish were discovered during a dip-net survey at Calabasas Pond. The population was small, and all crayfish were removed the same year. Adult invasive bullfrogs have been sporadically observed on the Calabasas and Ellicott Units. In 2006, a large, productive breeding population of bullfrogs was confirmed on the Harkins Slough Unit. In addition to bullfrogs, invasive carp have also been observed in large numbers at Harkins Slough Unit. There has been no control of bullfrogs or carp to date.

Trematodes, such as *Ribeiroia* sp., are parasitic flatworms that cause infection, limb abnormalities and a decline in survivorship in amphibians (Johnson et al. 1999). Primary hosts of the adult trematode include vertebrates such as birds. The bird releases the trematode eggs into the environment where they enter an intermediate host, such as aquatic planorbid snails, (*Planorbella tenuis*). Larval trematodes from the snail move to the second intermediate host, including frog and salamander larvae. The larval trematodes form cysts on the surface of the tadpoles' skin which penetrates the tissue, resulting in extensive inflammation, swelling, and tissue outgrowths (Johnson and Sutherland 2003). In the past 10 years, there has been one known outbreak of trematodes at the Ellicott Unit. In 2001, both treefrog tadpoles and SCLTS larvae were observed with multiple limbs. A few specimens were sent to the Health Center and resulted in a positive confirmation for the presence of trematodes on the Ellicott Unit (Loredo 2010).

3.5 Cultural Resources

An archaeological record search from the California State Historic Preservation Office (SHPO) was conducted for the Calabasas Unit in October 1998. No recorded archaeological resources are on the property. The parcel is located within an area where the likelihood of finding archaeological artifacts is high. However, the area has been significantly disturbed by recent agricultural operations, and it is unlikely that management activities would disturb any cultural sites and/or artifacts. In a 1993 environmental assessment done for the creation of Prospect Pond, the Service stated that there were no known archaeological sites at Ellicott Slough NWR (USFWS 1993). In 1993, Calabasas Unit was not a part of the Refuge and the 4.5-acre Lima family conservation easement was not included within the Refuge acquisition boundary. No additional information was found regarding archaeological sites on the Ellicott or Harkins Slough Units of the Refuge.

No cultural resources were identified in previous assessments done for the proposed golf course on the Buena Vista property (Carter 1993). The area is heavily vegetated, and only 20 percent of the area was surveyed. According to Miliken, the Native American Aptos/Cajastaca group lived in the area (Lonnberg 1994), though no historic resources have been observed in the vicinity. The Buena Vista property is within the historic Rancho San Andres lands, which was given to the Castro family in 1833 (Carter 1993).

There are no visible cultural elements on the Refuge units. Most of the Refuge is heavily vegetated, making visual surveys difficult to conduct.

3.5.1 Social and Economic Environment

The Refuge is located in Santa Cruz County, which is made up of the incorporated cities of Santa Cruz, Watsonville, Scotts Valley, and Capitola. Agriculture is the foundation of this area. This industry is limited to the marine terraces along the ocean and bay northwest of Santa Cruz, the section

of coastal plain southeast of Aptos, the lower hills of Corralitos-Watsonville, and the rich, alluvial soils in the Pajaro Valley. The Refuge is near many crop fields; crops in the area include artichokes, Brussels sprouts, strawberries, leeks, broccoli, flowers, and iceberg lettuce. Forestry is also an important industry in the area, according to the Santa Cruz County Resource Conservation District (2010).

Recreation and tourism are also important local industries. There are a number of state and county parks, including Big Basin State Park and Henry Cowell Redwood State Park, that attract visitors for hiking, marine sports, rock climbing, fishing and nature study activities.

The county has also encountered rapid population growth, creating pressure on water and soil resources, as well as forested, agricultural, and open space areas.

3.5.2 Demographics

There are approximately 250,000 residents in Santa Cruz County. The age group distributions are 19–64 years old (61.3 percent); 5–18 years old (21.5 percent); 65 years old and over (10.6 percent); and under 5 years old (6.6 percent). The ethnic demographic is divided primarily between White persons not Hispanic (62.9 percent); Hispanic or Latino (29.3 percent); Asian (4.1 percent); Black (1.3 percent); American Indian and Alaska Native (1.2 percent); and Native Hawaiian and Other Pacific Islander (0.2 percent). The per capita personal income in 1999 was $26,396, and the 2008 median household income was $66,495 (USCB 2008).

3.5.3 Traffic and Public Access

Although the Refuge is closed to the public, vehicular traffic does occur on the surrounding roadways and—in the case of the Ellicott Unit—through the Refuge.

San Andreas Road, a major Santa Cruz County coastal road, is located on the western border of the Ellicott Unit. The busy thoroughfare divides the main body of the unit from six acres of unit upland habitat on the opposite side of the road. A second private road, Peaceful Valley Drive, bisects the main portion of the unit and serves as the primary access road for residential and business neighbors in the valley to the east of the unit. Habitat fragmentation due to roads has been an on-going cause for concern, as vehicle strike mortality of SCLTS, CTS, and Pacific tree frog continues to be recorded during amphibian migration surveys (USFWS 1999b, USFWS 2004, D. Kodama, pers. comm.).

The Calabasas Unit and Buena Vista property are surrounded by county and private roads leading to rural residences and small farms. Traffic in these areas tends to be sparse, with residents of the area being the main users of the roads.

Prior to a portion of the road being permanently closed due to flooding, Harkins Slough Road, adjacent to the Harkins Slough Unit, was used as a road crossing, connecting the west and east sides of the Harkins Slough waterway. Subsequent to the road closure, traffic on Harkins Slough Road has been reduced, limited to use from the surrounding facilities and residences on the west side of the waterway.

3.5.4 Local Economy and Employment

Santa Cruz County's economy is anchored by high technology, agriculture, and tourism. The Refuge is within San Cruz County limits but does not provide any employment opportunities because there are no on-site facilities. Access to the Refuge is monitored and limited to Refuge staff, volunteers, and Special Use Permit holders due to the sensitive nature of the wildlife.

3.5.5 Environmental Justice

On February 11, 1994, the President issued Executive Order 12898 (*Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*), which directs the U.S. Environmental Protection Agency (EPA) to ensure that agencies analyze environmental effects on minority and low-income communities. The purpose of the Executive order is to avoid the disproportionate placement of any adverse environmental, economic, social, or health impacts resulting from Federal actions and policies on minority and low-income populations. Minority and low-income populations are present in Santa Cruz County in the vicinity of the Refuge (see the environmental assessment, Appendix C, for an analysis of potential effects to minority and low income populations).

Coast live oak and lupine. Photo: USFWS

Chapter 4. Current Refuge Management and Programs

The Refuge currently has no integrated plan to guide the management of all of its resources and uses. Current management efforts focus on the protection of sensitive species, the enhancement of their habitats, and the management of the environmental education program. A major emphasis of current management is the protection and monitoring of threatened and endangered salamanders.

4.1 Land Management

The Refuge lands are currently closed to the public to protect sensitive habitat for Federally-listed species. The primary land management activities conducted by Service staff, partners, and volunteers include reducing invasive vegetation and native plant restoration. Invasive vegetation (e.g., eucalyptus, pampasgrass, hemlock) is removed using mechanical and chemical methods. Seeds from native plants are harvested for propagation at the native plant nursery located on the Don Edwards San Francisco Bay NWR in Fremont. Restoration plantings occur in areas that were cleared of invasive vegetation. Volunteers and staff also have been developing a comprehensive plant species list and specimen catalog.

4.2 Water Management

Very little water manipulation occurs in the ponds on the Refuge. The Ellicott Unit has a pump and well to augment water levels, when needed, to ensure Santa Cruz long-toed salamander (SCLTS) and California tiger salamander (CTS) population recruitment. The Ellicott Unit has a second well without a pump in preparation for a breeding pond (Prospect Pond) that was constructed, but is being re-designed to improve hydrologic function. Water rights for Calabasas Pond from Harkins Slough (from the State of California Resources Agency, State Water Resources Control Board) were acquired in 1967 and transferred to the Refuge with the acquisition of the property. With the addition of a new berm and water structure at Calabasas in 2006, the Refuge is now able to partially control water output.

4.3 Wildlife Management

Wildlife management activities are conducted by the Service, partners, and/or volunteers on the Refuge. Activities generally focus on unit surveys for listed amphibians, but other wildlife is also recorded on these surveys. Amphibian surveys—dependent on rain events, funding, expertise, and staff availability to travel to the Refuge—are not always conducted consistently. Night-time amphibian roadside surveys to assess SCLTS and CTS population recruitment and amphibian health and to compile data on mortality from vehicle strikes are conducted when possible by staff and volunteers during annual rain events. Staff and volunteers also conduct annual dip-net surveys to determine breeding occurrence and health assessment of amphibian larvae and tadpoles. Coverboard surveys are conducted to collect baseline data on wildlife species diversity, focusing on reptiles, amphibians, small mammals, and invertebrates.

Additional staffing and expertise is necessary for more complex types of surveys such as drift fence, pitfall, and malformation studies. These do not occur on a regular basis—only when funding opportunities arise. A drift fence and non-lethal pitfall trap survey was conducted on the Buena Vista property in 2008 to gather baseline SCLTS and

California tiger salamander. Photo: Gerald and Buff Corsi © California Academy of Sciences

Coverboard survey. Photo: USFWS

CTS population data. The Refuge has participated in nationwide malformed frog surveys over the last several years to determine the prevalence of abnormalities on refuges.

A bird species list has been created based upon tours led by the Santa Cruz Bird Club and Open Space Alliance (Santa Cruz), incidental sightings, and past bird surveys.

4.3.1 Mosquito Population Management

Mosquito management activities occur throughout the Monterey Bay region where there is a large (more than 700,000) human population and where there is a long history of mosquito management and documented mosquito-borne disease transmission to humans and wildlife. Mosquitoes can be vectors of disease to both humans and wildlife and, in some cases, the disease transmission can result in death. Ten California species of mosquito that are known vectors of arboviruses or known as major pests were evaluated for West Niles Virus (WNV) transmission in 2002. All 10 species were infected with WNV and were able to transmit the disease at some level (Goddard et al. 2002). *Culex tarsalis* is considered one of the most efficient laboratory vectors of WNV tested from North America and is abundant in California and much of western North America, where it is involved in the maintenance and amplification of western equine encephalomyelitis virus and Saint Louis encephalitis virus (Goddard et al. 2002). *Culex tarsalis* larvae are typically found in irrigation ditches, ponds, storm sewers, and other areas that usually contain abundant organic material. Of the 10 mosquito species studied by Goddard, *Culex tarsalis* showed the greatest potential to amplify and maintain WNV in California. The mosquito species most abundant on the Refuge is *Ochlerotatus wachinoi*, a species not known to vector disease.

With the spread of WNV and the potential for spread of other mosquito-borne disease across the country, there is increasing pressure to manage mosquito populations that occur on lands of the National Wildlife Refuge System (NWRS), especially in urban areas such as the Monterey Bay area. The Service understands that mosquitoes are a natural component of wetlands, but we also recognize that they may pose a threat to human and/or wildlife health. NWRS policy allows native mosquitoes to exist unless they pose a specific wildlife and/or human health threat.

The Santa Cruz County Mosquito and Vector Control (SCCMVC) District has records of their treatment of the Ellicott Slough National Wildlife Refuge for mosquito management dating back to 1995. The SCCMVC District's use of pesticide on the Refuge has been monitored and regulated through the Service's annual Pesticide Use Proposals and Special Use Permits. Refuge staff works cooperatively with the SCCMVC District to manage mosquito populations on the Refuge.

4.4 Fire Prevention and Hazard Reduction

The Refuge does not have on-site fire management staff or equipment. While there is no dedicated fire staff at the Refuge, fire prevention and containment on the Refuge is a high priority. Both natural and man-made fires present primary concerns for the Service. A Fire Management Plan was updated

in 2002, with the main objective of reducing fuel accumulations to decrease the potential for large wildland fires. Because Refuge staff and trained Service fire crews are far from the Refuge (90 miles away), all wildland fires are generally reported by the public and suppressed by local cooperating agencies (Aptos-La Selva Fire District and Cal Fire) with oversight from the Service. During the past 10 years, two fires have been reported on the Refuge. In 2007, Cal Fire responded to an arson-caused fire at the Harkins Slough Unit. Approximately seven acres of grasslands and one abandoned house were burned. In 2008, a fire of unknown cause was reported on the Ellicott Unit. Cal Fire responded to the fire, which burned approximately one-half acre of grassland and eucalyptus.

With coordination and funding from the Service's Wildland Urban Interface program, the Refuge has worked to reduce hazardous fuel loads on the Ellicott Unit. Invasive plant fuel loads such as eucalyptus and pampasgrass have been mechanically removed with the assistance of California Conservation Corps (CCC), Cal Fire workforce crews, and Service fire crews stationed part-time at San Luis National Wildlife Refuge Complex. Other fuel reducing and fire prevention projects have included maintaining fire roads and creating a fire break between the Refuge and the neighboring KOA campground.

4.5 Law Enforcement and Resource Protection

Law enforcement officers assigned to the San Francisco Bay National Wildlife Refuge Complex provide law enforcement support at the Refuge. Local CDFG wardens also assist with patrol. Due to the distance from Complex headquarters office in Fremont (where officers are stationed), the Santa Cruz County Sheriff's office is the first responder in emergency situations.

Currently all units of Ellicott Slough NWR are closed to the public except for research and surveys approved by Refuge staff, habitat restoration projects, and the Refuge's environmental education program with Renaissance High School.

Although portions of the Refuge are fenced and/or posted with "area behind this sign closed" and boundary signs, unauthorized use does occur. Unauthorized hiking and biking have been periodically observed on all units. Another common violation is illegal trash dumping.

The Calabasas Unit has been subject to off-road vehicle use (e.g., ATV and motorcycle) and horseback riding both in the upland habitat and in the ephemeral breeding pond during its summer dry-down cycle. These unauthorized uses have been detrimental to the Refuge in that they have damaged sensitive pond habitat, jeopardized juvenile salamanders over-summering in the dry pond footprint, and created trails through upland habitat, which promotes erosion, the spread of invasive weeds, and further unauthorized use.

Unauthorized recreational fishing occurs at the Harkins Slough Unit. Because there is no public infrastructure in place on the unit or regular Refuge presence, this illegal use has resulted in cut fences, vandalized signs, unauthorized trail and bank clearing, and trash accumulation. The abandoned houses and buildings on Harkins Slough Unit have also attracted vandals and illegal campers.

The Service has a 17.4-acre Farm Service Agency easement on the Theriault property located on Corralitos Creek, approximately 10 miles from the Ellicott Unit. This Theriault easement is not part of the Refuge, but the Refuge has management responsibilities to oversee and monitor the terms of the agreement for resource protection.

4.6 Cultural Resource Management

The Refuge complies with all applicable regulations and statutes regarding cultural resources. In consultation with the State Historic Preservation Officer and the Tribal Historic Preservation Officer (if applicable), the Service evaluates the eligibility of cultural resources, traditional cultural properties, and unique archeological resources on the Refuge prior to undertaking ground disturbing activities.

4.7 Facilities Maintenance

There are limited infrastructure and facilities located at the Refuge. All of the units have some fencing, signs and gates. Structures on the Ellicott Unit include a Pacific Gas and Electric (PG&E) power box, which supplies electricity to a pump

installed in a well located on Service property, and power lines and poles that run through the Refuge. The pump and well on Ellicott Unit are used to augment pond water levels during drought years to ensure metamorphosis of SCLTS. Prospect Pond, a pond constructed in 1997, is being redesigned to remedy hydrologic issues. The Calabasas Unit has a water control structure and berm at the southwestern end of the Calabasas Pond. There are also some remnant structures (house, barn, well, and associated facilities) remaining from the previous owner on the Harkins Slough Unit.

All residential houses and farm buildings on the Harkins Slough Unit have been evaluated for structural integrity by Refuge maintenance and were found to be structurally unsound. The abandoned state of the structures (broken window glass, stripped metal wiring, and general vandalism) has also added to the hazardous conditions. Five unused wells for residential use and irrigation have also been noted on the unit.

4.8 Safety

Safety is a priority concern at the Refuge. Poison oak, ticks, bees, and wasps are the most common issues facing staff and volunteers. There is also the potential to have mountain lion or bobcat and human interactions on the Refuge. Local fire, police, and emergency medical responders are able to provide services to each of the units; however, due to a lack of cell phone reception, response time to the Refuge may not be rapid. A safety officer from the San Francisco Bay NWR Complex conducts a safety audit of the Refuge annually.

4.9 Volunteers and Partners

Volunteers and partners provide countless hours of service for needed management activities on the Refuge. Management of this Refuge is reliant on relationships with these partners to provide maintenance, monitoring, assistance with land protection, and a variety of resources. The Refuge has benefited from partnerships with several entities and individuals, including:

- Biosearch Associates
- California Conservation Corps
- California Department of Fish and Game
- Cal Fire
- Land Trust of Santa Cruz County
- Open Space Alliance, Santa Cruz
- Renaissance High School
- San Francisco Bay National Wildlife Refuge Complex Volunteers
- Santa Cruz Bird Club
- Santa Cruz County Weed Management Area
- Trust for Public Land
- Watsonville Wetlands Watch

4.10 Visitor Programs

The Refuge has restricted public access on some of the units based on the sensitivity and limited distribution of Federally-protected species that the Refuge supports. The Ellicott and Harkins Slough Units have restricted access, with Service-guided interpretive walks, as requested by resource-related organizations. Service-guided environmental education is also offered at the Ellicott Unit. Permitted on-site activities are supervised by Refuge staff to minimize disturbances to wildlife and habitat and to contribute to the management practices of the Refuge. The Calabasas Unit is closed to the public.

4.11 Environmental Education and Interpretation

The Refuge currently partners with Renaissance High School, located across from the Ellicott Unit on Spring Valley Road, to provide a program that focuses on bringing students to the Refuge, where they can connect directly with wildlife and habitat resources. The goal is to promote awareness and foster a sense of stewardship towards the local watershed, threatened and endangered species, and migratory birds.

The program begins with an in-classroom component introducing students to the Refuge, local natural resources, and the Service. Throughout the school year, students participate in Refuge-guided field trips (tours), assisting staff with restoration activities such as invasive weed removal, native seed collection, and plantings. Students also work with Refuge staff to learn the fundamentals of survey data collection.

Results and observations from these surveys are entered into Refuge resource databases and included on species lists. At the end of the school year, students summarize their experience and newly gained knowledge with a final project or report.

4.12 Fishing and Hunting

Recreational fishing and hunting are not currently permitted on the Refuge. However, unauthorized recreational fishing occurs at the Harkins Slough Unit. The Refuge has restricted public access due to the sensitivity and limited distribution of Federally-listed species that the Refuge supports.

4.13 Wildlife Observation and Photography

Wildlife observation and photography are not currently permitted on the Refuge. The Refuge has restricted public access due to the sensitivity and limited distribution of Federally-listed species that the Refuge supports. See Visitor Programs, above.

4.14 Outreach

Refuge outreach is conducted primarily through off-site presentations requested by wildlife related organizations, and booths at local festivals such as the Santa Cruz Migration Festival. Information on the Refuge, the Service, and Federally-listed species is provided. Booth activities are geared towards teaching children and adults about Santa Cruz long-toed salamander natural history and its unique local geographic range.

Chapter 5. Management Direction

5.1 Ellicott Slough NWR Vision Statement

Veiled in lush canopies of oak woodland and coastal chaparral, Ellicott Slough National Wildlife Refuge is one of the few refuges established for amphibians. First established for the endangered Santa Cruz long-toed salamander, the Refuge also supports the threatened California tiger salamander and the threatened California red-legged frog. The Refuge will sustain, restore, and acquire vital wetland and upland components to provide habitat for the entire lifecycle of amphibian populations within the Watsonville Slough System of the Pajaro Valley Watershed. Amphibians and other wildlife will flourish in the Refuge's protected seasonal ponds, oak woodland, and chaparral. The Refuge will also serve to protect the diminishing natural landscape of the Santa Cruz area, which is critical to the survival of other threatened, endangered, migratory, and other native species.

The Refuge, surrounded by agricultural fields and houses, will also strive to connect with the public in nature by providing wildlife observation, photography, and interpretation and environmental education opportunities that connect the Refuge to the local community. The Refuge staff will continue to establish and strengthen partnerships with the community, conservation groups, academia, and other agencies. These partnerships will conserve and restore habitats vital to the survival of the plants and wildlife of the Refuge.

5.2 Refuge Management Goals, Objectives, and Strategies

Refuge management activities are articulated through goals, objectives, and strategies in this CCP. The Service defines a goal as a "descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose, but does not define measurable units."

The Service defines objectives as concise statements of what will be achieved, how much will be achieved, and when and where it will be achieved on a refuge. Objectives are derived from goals and are accomplished through management strategies that specify the actions, tools, techniques, or combination thereof. Goals were developed to provide management directions in four principal areas: wildlife management, habitat management, wildlife-dependent public use, and cultural or wilderness resources. The seven Refuge goals are presented in the following text, followed by detailed descriptions of the associated objectives, strategies, and rationales that support and implement them.

GOAL 1: Restore, protect, and enhance native and special status amphibian populations in Santa Cruz County.

Objective 1.1 Conduct research and monitoring to determine baseline population size, health, habitat use, and movement of native amphibians, especially special status species.

Rationale: Federally-listed threatened, endangered, and candidate species are trust responsibilities under the jurisdiction of the Service. Threatened and endangered species, as well as those proposed for Federal listing, may become extinct due to environmental factors. Listed amphibian species known to occur on the Refuge include the Santa Cruz long-toed salamander (SCLTS), California tiger salamander (CTS), and California red-legged frog (CRLF). The 1999 Revised Recovery Plan for Santa Cruz long-toed salamander and the 2002 Recovery Plan for the California red-legged frog identify the need for monitoring to assess status, trends, habitat use, and threats to develop appropriate recovery actions. Refuge management strategies will support these objectives. Furthermore, understanding how listed species interact with their environment and other wildlife will support their recovery.

Strategies

1.1.1 Identify inventorying, monitoring and research needs for determining population size, habitat use, and movement of native amphibians (e.g., identify amphibian dependence on small mammal burrows).

1.1.2 Prioritize and determine who can fulfill the inventory, monitoring, and research needs (e.g., staff, partners, universities).

1.1.3 Develop partnerships with researchers, universities, and others to conduct research and monitoring that supports the Refuge management needs and contributes to the scientific community.

1.1.4 Standardize monitoring, data collection, and storage.

1.1.5 Conduct monitoring to answer inventory and research needs.

1.1.5.1 Conduct quantitative night-time surveys (during most rain events) to assess population recruitment, and compile data on mortality from vehicle strikes.

1.1.5.2 Conduct annual quantitative dip-netting and coverboard surveys to obtain baseline information, determine breeding occurrence, and health assessment of larvae and tadpoles.

1.1.5.3 Conduct pond and upland drift fence and nonlethal pitfall trap surveys to determine baseline population size and movement trends to assist with identifying high quality habitat requirements and informing restoration decisions.

1.1.5.4 Conduct surveys for presence of California red-legged frog (e.g., call counts, seining, eye shine, and dip-net).

1.1.5.5 Conduct genetic studies to assess population parameters (e.g., effective population size and population subdivision).

1.1.6 Participate in nationwide abnormal frog surveys to determine the prevalence of abnormalities in frogs and toads on refuges; evaluate how abnormality frequencies vary among sites, refuges, and years; and investigate possible causes of the abnormalities through targeted follow-up studies.

Night-time survey. Photo: USFWS

Objective 1.2 Within 10 years of Plan approval, develop and/or implement management actions for ephemeral breeding ponds (Ellicott Pond, Calabasas Pond, and Buena Vista Pond) and over-summering habitat to support native and special status amphibian recruitment.

Rationale: The 1999 Revised Recovery Plan for Santa Cruz long-toed salamander and the 2002 Recovery Plan for the California red-legged frog identify the need to ensure that existing ponds remain functional breeding sites as a core recovery objective. Refuge management strategies will support this recovery objective.

Strategies

1.2.1 Develop a Water Management Plan to ensure that existing ponds remain functional breeding sites.

1.2.2 Conduct hydrological and soil surveys for existing ponds to inform management actions.

1.2.3 Conduct hydrological and soil surveys to inform management actions regarding potential pond construction locations and ponds for potential future acquisition.

Ellicott Pond. Photo: USFWS

1.2.4 Monitor ponds for siltation, as well as for native and invasive vegetation encroachment. Summarize data to determine need for excavation or vegetation removal.

1.2.5 Continue the planning, redesign, and environmental compliance for existing, non-functional breeding pond (Prospect Pond).

1.2.6 Assess the need for and—where appropriate—plan, design, and complete environmental compliance for additional new breeding ponds.

1.2.7 Monitor and research over-summering needs (e.g., grassland, oak woodland) and incorporate results into restoration efforts and management.

Objective 1.3 Within 10 years of Plan approval, conduct feasibility study of potential to restore Harkins Slough Unit to provide additional native amphibian habitat.

Rationale: The 1999 Revised Recovery Plan for Santa Cruz long-toed salamander and 2002 Recovery Plan for the California red-legged frog identify the need to restore habitat for amphibians at or near their historical localities. The Watsonville Slough System, which includes Harkins Slough, historically and currently provides habitat for these species. Refuge management strategies will support this guideline.

Strategies

1.3.1 Conduct a hydrological assessment of Harkins Slough.

1.3.2 Identify threats to the survival and reproduction of native amphibians, and—if feasible—remove or reduce threats.

Objective 1.4 Identify and prioritize direct (e.g., vehicle strike mortality, disease) and indirect (e.g., contaminants) threats to amphibians to develop appropriate response measures.

Rationale: The 1999 Revised Recovery Plan for Santa Cruz long-toed salamander and 2002 Recovery Plan for the California red-legged frog identify controlling or eliminating invasive species and/or predators as a recovery task for these species. These two Recovery Plans also identify reducing human-related mortality (e.g., vehicle strike) as recovery tasks. Refuge management strategies will support these guidelines.

Strategies

1.4.1 Work with partners to minimize vehicle strike mortality (e.g., install reduce-speed signs, implement an outreach program) and minimize additional barriers to movement on and adjacent to the Refuge.

1.4.2 Assess long-term vehicle strike mortality solutions with other stakeholders (Santa Cruz County, Transportation Division of Santa Cruz County, and Southern Pacific Railroad); solutions may include elevating San Andreas Road, creating tunnels under roads, and road closures during rain events.

1.4.3 Understand and determine effects of pesticides, including herbicides and mosquito abatement procedures (e.g., conduct literature review, research).

1.4.4 Understand and determine sources of contaminants (e.g., road runoff, livestock runoff, and agricultural practices), their effects, and prevalence through surveys and research. If warranted, plan

and implement course of action to decrease exposure to affected areas.

1.4.5 Research spread of disease and parasites among native amphibians and follow best management practices to prevent their spread (see Appendix 1 of the Environmental Assessment, within Appendix C).

1.4.6 Conduct surveys annually to monitor amphibian health (See Objective 1.1).

1.4.7 Rapidly respond to amphibian parasite and disease outbreaks by identifying, documenting, and notifying National Wildlife Health Center, local herpetologists and additional experts.

1.4.8 Assess prevalence of invasive plants and animals (See also Objectives 4.1 and 4.2).

1.4.9 Protect sensitive refuge resources from potentially adverse effects of wildfires using fire suppression actions, prescribed fire, manual and mechanical techniques. In planning a prescribed fire and mechanical treatments, sensitive resources are taken into account, and mitigation measures are implemented to protect them.

Objective 1.5 Within five years of Plan approval, develop a map to identify suitable amphibian habitat and buffers for protection in perpetuity through fee acquisition and easements.

Rationale: The 1999 Revised Recovery Plan for Santa Cruz long-toed salamander and 2002 Recovery Plan for the California red-legged frog have developed recovery recommendations, including protecting and acquiring suitable habitats and buffers for these species. Refuge management strategies will support these guidelines.

Strategies

1.5.1 Identify critical breeding, over-summering, and movement or migration corridors outside of the Refuge.

1.5.2 Work with partners (e.g., local, state, and Federal land protection agencies and organizations, such as the Land Trust of Santa Cruz County, Trust for Public Land, Open Space Alliance, and California Department of Fish and Game) to prioritize these land parcels for protection and acquisition.

1.5.3 Expand Refuge acquisition boundary based on prioritized land properties.

Objective 1.6 Within five years of Plan approval, establish working group to discuss current management actions occurring on the Refuge and identify future needs.

Rationale: Because the Refuge manages non-contiguous units in the Watsonville Slough area, connectivity between the units is nearly impossible. However, there are several partners in the area that manage lands for amphibians and have the potential to help guide future management of Refuge resources. Working with partners on a regular basis will help establish consistent management of native amphibians in the area.

Strategies

1.6.1 Collaborate annually with researchers and land managers to share latest information and results of studies to base management actions on best data available.

1.6.2 Attend local and national amphibian conferences to share and learn about current information (e.g., research results).

GOAL 2: Conserve, restore, and enhance migratory and other native wildlife populations.

Objective 2.1 Within 10 years of Plan approval, conduct baseline surveys for presence and abundance of birds, fish, mammals, reptiles, and invertebrates to determine species diversity at all Refuge units.

Rationale: The Refuge System Policy on Biological Integrity, Diversity and Environmental Health (601 FW3) (BIDEH) charges Refuge staff to assess the Refuge resources through baseline population surveys and studies. Documentation of the occurrence of fish and wildlife species will meet management needs. Monitoring changes in fish and wildlife resources is needed to inform management decisions or to develop, refine, and evaluate achievement of fish, wildlife, and habitat management objectives. Survey data may also support regional population needs beyond the Refuge.

Strategies

2.1.1 Develop standardized quantitative and qualitative monitoring protocols to be repeated at intervals, depending on the species.

2.1.2 Develop database that incorporates new and historic data, including spatial information (GIS) on core areas.

2.1.3 Conduct surveys using methods such as pitfall, coverboard, and black light to identify reptile and invertebrate species.

2.1.4 Seek partnerships to conduct bird surveys at all the units, with particular emphasis on Harkins Slough.

2.1.5 Seek partnerships to identify fish species at Harkins Slough.

2.1.6 Conduct mammal surveys (e.g., live-trapping, remotely-triggered photo stations, track identification, and scat identification).

GOAL 3: Conserve, restore, and enhance grassland, wetland, oak woodland, coastal scrub and chaparral plant communities, and special status plant species representative of Santa Cruz County.

Objective 3.1 Conduct comprehensive vegetation sampling on each Refuge unit every 10 years.

Rationale: Knowledge of the distribution and abundance of species, species' needs, and status is critical for the management of the Refuge. Management effectiveness can be evaluated and corrected, if needed, based on information gathered from sampling. Sampling will also support regional needs and can result in early response to invasive vegetation.

Strategies

3.1.1 Conduct initial baseline vegetation sampling within five years.

3.1.2 Develop long-term monitoring protocols such as transects, quadrants, and other methods to track changes over time.

3.1.3 Using GIS, map sensitive plant species and target plant communities, including coastal scrub and maritime chaparral, within five years.

3.1.4 Coordinate with local botanists, garden clubs, the California Native Plant Society (CNPS), universities, volunteers, or others to assist in vegetation sampling.

Objective 3.2 Within five years of Plan approval, determine the distribution of robust spineflower, and possible presence of Santa Cruz tarplant (*Holocarpha macradenia*), and other Federally- and CNPS-listed plant species on the Refuge.

Rationale: The 2004 Recovery Plan for robust spineflower identifies the Buena Vista unit and surrounding areas as important locations for the spineflower. Robust spineflower is currently found on the Ellicott Unit and the Buena Vista property; however, population estimates are not known or not current (respectively). While the Santa Cruz tarplant and other listed plant species can be found near the Refuge, the extent of these species on the Refuge is also not known.

Strategies

3.2.1 Using GIS, map current populations of robust spineflower on the Refuge.

3.2.2 Identify extent of special status and rare species such as Santa Cruz tarplant.

3.2.3 Conduct plant surveys and mapping of the entire Refuge. Sample a sub-set area at each Refuge unit every 3–5 years, thereafter.

3.2.4 Coordinate with experts about current, improved, or new techniques to increase populations.

3.2.5 If warranted, consider plant propagation through appropriate local sources.

Objective 3.3 Within five years of Plan approval, develop a Habitat Management Plan including an adaptive vegetation management plan.

Rationale: An adaptive vegetation management plan will efficiently coordinate and prioritize the resources and methods needed to restore and maintain native habitat. The plan will also facilitate

the identification of and prioritize threats to the biological integrity of native habitats, enabling a quick response.

Strategies

3.3.1 Seek partners to assist in seed collection from native sources to propagate sensitive and/or native plant species.

3.3.2 In the development of a Habitat Management Plan, consider different methods such as chemical, mechanical, grazing, and prescribed fire to benefit the wide variety of habitats (e.g., native grassland community) that exist on the Refuge.

3.3.3 Develop and implement protocols for disease and pest monitoring (e.g., sudden oak death, pine bark beetle) and rapid response actions.

GOAL 4: Conserve and restore Refuge resources through the prevention and control of invasive species.

Objective 4.1 Within the adaptive vegetation management plan, complete and implement an adaptive invasive weed management plan that prioritizes, evaluates, and emphasizes early detection and rapid response efforts.

Rationale: Invasive species have become the primary threat to the Refuge System and the Service's wildlife conservation mission. Invasive species have the potential to alter foraging, nesting, and roosting habitat of endangered species and other wildlife that occur on the Refuge. The biological integrity policy identifies the need to control invasive vegetation. The Refuge's proximity to urban environments also highlights the importance of vigilant monitoring of Refuge units. The National Strategy for Management of Invasive Species (April 2003) has been developed within the context of the National Invasive Species Management Plan [EO 13112], which functions as the internal guidance document for invasive species management throughout the Refuge System. The Plan identifies four goals: 1) Increase the awareness of invasive species issues, both internally and externally; 2) Reduce the impacts of invasive species to allow the Refuge System to more effectively meet its fish and wildlife conservation mission and purpose; 3) Reduce invasive species impacts on the Refuge System's neighbors and communities; and 4) Promote and support the development and use of safe and effective integrated management techniques to deal with invasive species.

Strategies

4.1.1 Explore all feasible control techniques, such as chemical, mechanical, grazing, and prescribed fire.

4.1.2 If found to be applicable (in 4.1.1), develop a grazing and prescribed fire plan (See Objective 5.2).

4.1.3 Develop a baseline invasive vegetation map (See Strategy 3.1.1).

4.1.4 Conduct ongoing surveys through partners and volunteers to respond to new occurrences of invasive plant species.

4.1.5 Annually determine priority invasive plants based on monitoring results.

4.1.6 Control eucalyptus, jubatagrass, and pampasgrass through removal, using a variety of methods such as mechanical and chemical.

4.1.7 Determine methods for control of French broom, targeting outliers and then moving into established areas.

4.1.8 Consult with local partners to identify invasive weeds in the region that may be considered threats to the Refuge.

4.1.9 Develop prevention and early detection protocols to reduce the extent and density of newly established invasive plants to minimize spread and damage to natural resources.

4.1.10 Work with the Santa Cruz Weed Management Area to learn new control techniques, identify weeds new to the county, and create partnerships with local landowners.

4.1.11 Work with partners and neighbors to identify and control invasive plants (e.g., pampasgrass), facilitating cooperation among those working to manage invasive plants.

4.1.12 Implement the most economic, effective, and safe control methods for priority weed species, and monitor efficacy of control methods (e.g., by mapping).

Objective 4.2 Within 10 years of Plan approval, conduct a baseline assessment of and develop

Dip-netting at Calabasas Pond. Photo: USFWS

possible control methods for invasive wildlife threats to native amphibians.

Rationale: The presence, distribution and potential impacts of invasive competitors and predators of amphibians are not well understood on the Refuge. In addition, invasive wildlife species have unknown effects on the Refuge resources. As mentioned in Objective 4.1, invasive species are a primary threat and priority for the Refuge System. The strategies will meet the objectives in the Refuge System's National Strategy for Management of Invasive Species.

Strategies

4.2.1 Annually survey to assess prevalence of invasive competitors and predators (e.g., bullfrogs, crayfish, and fish) using methods such as call counts, electroshock, seining, eye shine, trapping, and dip-netting.

4.2.2 Based upon survey results, assess the control method options and potential impacts, and if feasible, implement control measures.

GOAL 5: Promote long-term viability of the Pajaro Valley Watershed through ecosystem-based management (including endangered and threatened species management across boundaries).

Objective 5.1 Coordinate with existing public and private partnerships and create new ones that focus on ecosystem-based management collaborations that will support the long-term management of Refuge resources.

Rationale: The Refuge is made up of non-contiguous units, making it difficult to provide any connectivity between wildlife populations. Acquiring additional lands for buffer and breeding habitat will be critical to the recovery of listed species. The Refuge staff intends to work with surrounding partners to encourage land use practices and potential acquisitions that will support the needs of the Refuge's wildlife. The Refuge is also reliant on the Pajaro Valley Watershed for its water needs to provide breeding habitat to these species. Both water quality and quantity are influenced by numerous neighboring land uses, which will require coordination to protect this watershed. To ensure that Refuge needs are addressed, Refuge staff will need to take an active role in regional planning.

Strategies

5.1.1 Expand collaboration with the following partners to develop long-term ecosystem goals for the watershed: California Department of Fish and Game, Watsonville Wetlands Watch, Elkhorn Slough National Estuarine Research Reserve, Land Trust of Santa Cruz County, Trust for Public Land, and Elkhorn Slough Foundation.

5.1.2 Develop new partnerships with USGS, National Audubon Society, Coastal Conservancy, and other local, state, and Federal land protection agencies and organizations.

5.1.3 Work with partners to prioritize lands within the watershed for protection and acquisition (see Objective 1.5).

Objective 5.2 Reduce wildfire risk at the Wildland Urban Interface (WUI) to minimize risk to public safety and to the Refuge and surrounding resources.

Rationale: The Fire Management Plan (FMP) for Ellicott Slough, revised in 2002, outlines procedures

for wildland fire suppression. The FMP furthers the mission of the Refuge by providing increased protection for Refuge resources. Increasing coordination and preparedness to suppress wildland fires will help ensure quick responses to fires, which have the potential to be devastating to Refuge resources and adjacent properties.

Strategies

5.2.1 Identify and map WUI areas, hazardous fuel (e.g., vegetation, structures) locations, and sensitive Refuge habitat. Prioritize fuel removal based on this information.

5.2.2 Work with local fire departments, California Department of Forestry and Fire Protection (CAL FIRE), and the Service's fire management representatives to review annually and revise Fire Management Plans, as necessary, to include updated best management practices for fire prevention, fuel reduction strategies, and access.

5.2.3 Develop protocols with local partners to respond to fire outbreaks.

5.2.4 Work with partners and neighbors to make boundaries fire resistant in accordance with local fire codes and endangered species permits (e.g., hazardous fuel reduction, fuel breaks).

5.2.5 Remove hazardous fuel loads through manual, grazing, mechanical, and prescribed burn methods.

5.2.6 Monitor fuel reduction and assess effectiveness.

GOAL 6: Identify, assess, and adapt to current and future climate change impacts to Refuge resources.

Objective 6.1 Within 10 years of Plan approval, conduct an analysis of climate-related scenarios for the Refuge through modeling, and assess potential impacts to Refuge resources in coordination with the regional office.

Rationale: Climate change is already affecting wildlife throughout the State (Parmesan and Galbraith 2004), and its effects will continue to increase. Wetlands are especially sensitive to climate change. Nicholls et al. 1999 estimated that 22 percent of wetland loss will be due to inundation, primarily through sea-level rise and other human factors. Climate change is also expected to result in changes to weather patterns (e.g., stronger hurricanes, hotter temperatures, more precipitation) and changes in responses to changes in weather patterns (e.g., changes in migration, shifts in habitat, earlier budding of vegetation) (Pew Center 2009). This objective also helps achieve Statewide Conservation Action I in the California Wildlife Action Plan (CDFG 2005).

Strategies

6.1.1 Conduct flood-risk and climate-risk analysis of lands on and adjacent to the Refuge.

6.1.2 Work with Service experts and others to conduct and analyze climate change modeling to predict habitat changes for Refuge habitat types (e.g., sea-level affecting marshes model [SLAMM] modeling).

6.1.3 Obtain climate change modeling results applicable to the Refuge through other agencies and partners.

6.1.4 Identify additional acquisition needs based upon habitat transitions predicted from climate change models.

6.1.5 Promote and support research (through other agencies, universities, and consultants) that evaluates climate change related effects to endangered species populations and ephemeral pond hydrology, including analyzing changes in rainfall patterns (e.g., duration, timing, and amount) and temperature (e.g., air, water).

6.1.6 Identify locations for pond creation and acquisition (existing ponds or future pond sites) to offset climate change impacts (See Objective 1.5).

6.1.7 Assess effects of climate change on invasive species (e.g., weeds, bullfrogs).

6.1.8 Assess effects of climate change on disease outbreaks and parasites (e.g., monitoring presence of Rana viruses and chytrid in amphibians in relation to rising ambient and pond water temperatures).

6.1.9 Assess saltwater intrusion (i.e., effects on plants, wildlife) for Harkins Slough as a result of sea-level rise.

Objective 6.2 Within 10 years of Plan approval, measure the carbon footprint for the operation of the Refuge, and implement mitigation measures to offset the Refuge's carbon footprint.

Rationale: This objective meets with the Service's Climate Change policy, which recommends reducing Refuge staff carbon footprint to offset climate change impacts. The Refuge could also serve as a leader in the community to encourage neighbors to reduce their own carbon footprints.

Strategies

6.2.1 Using outside expertise, assess the Refuge's carbon footprint.

6.2.2 Improve efficiency where feasible (e.g., transportation, energy, recycling).

6.2.3 Educate and empower Refuge visitors about climate change effects on Refuge resources and green activities that offset climate change.

GOAL 7: Provide the public with accessible, safe, high-quality wildlife-oriented recreation and environmental education opportunities to enhance public appreciation and understanding of the natural resources of the Refuge and the Refuge System.

Objective 7.1 Within 10 years of Plan approval, remove buildings and other potential safety hazards on the Harkins Slough Unit to prepare the unit for public access.

Rationale: The Harkins Slough Unit contains several structures and wells that are safety hazards. The abandoned structures are in a deteriorated state and structurally unsound, and they attract vandals and vagrants. Providing a safe public environment is a priority that must be addressed before allowing public access. Prior to opening the Harkins Slough Unit to public use, all safety hazards will be addressed. The houses and structures will be demolished and materials removed from the property. The houses are known to contain asbestos and lead paint, for which safety guidelines and laws for removal apply. All wells not used for Refuge management purposes will be permanently capped. Wells that remain in use will be securely locked and fenced.

Strategies

7.1.1 Cap existing wells in accordance with state regulations prior to allowing public access at Harkins Slough Unit.

7.1.2 Remove existing abandoned buildings in accordance with state regulations prior to allowing public access at Harkins Slough Unit.

7.1.3 Install gate at Harkins Slough Unit for staff access.

7.1.4 Conserve the Refuge's cultural resources in accordance with all applicable laws.

Objective 7.2 Research, assess, and address mosquito-borne disease risks that may affect public use, health concerns, and Refuge resources.

Rationale: National Wildlife Refuge System policy allows native mosquitoes to exist unless they pose a specific wildlife and/or human health threat. The Refuge Administration Act, as amended, clearly establishes that wildlife conservation is the singular NWRS mission. House Report 105-106 accompanying the National Wildlife Refuge System Improvement Act of 1997 states "...the fundamental mission of our System is wildlife conservation: wildlife and wildlife conservation must come first."

Avian and human diseases such as West Nile Virus are known to be transmitted through such vectors as mosquitoes. The Service will continue to work with the local mosquito and vector control district to avoid and reduce potential disease and nuisance mosquito outbreaks. Mosquito control activities will continue on the Refuge until a more comprehensive mosquito management plan can be completed to determine the precise character, extent, and level of abatement activity. The Service will work with the district to develop a plan that allows mosquito management on Refuge lands, when necessary to protect the health and safety of the public or a wildlife population, using effective means that pose the lowest risk to wildlife and habitats. In conjunction with preparing a Mosquito Management Plan, the Service will comply with all applicable environmental laws, including NEPA.

Strategies

7.2.1 Continue mosquito control activities through the Santa Cruz County Mosquito and Vector District and CDFG for public safety and protection of Refuge resources.

7.2.2 Develop a Mosquito Management Plan, including thresholds for control, assessment of control methods, and best management practices.

7.2.3 Consider alternative methods to chemical mosquito control, such as grazing and mowing, to reduce vegetation within wetlands that may harbor mosquitoes. (See also Strategy 3.3.2.)

Objective 7.3 Ensure the safety of resources, property, and visitors.

Rationale: Increased safety measures would enable the Refuge to better fulfill its conservation mission and ensure improved experiences for Refuge visitors.

Strategies

7.3.1 Increase law enforcement patrols.

7.3.2 Develop cooperative agreements with state and local agencies to support increased law enforcement patrols.

Objective 7.4 Within 10 years of Plan approval, work with stakeholders of the Pajaro Valley Watershed to assess fishing opportunities in Harkins Slough.

Rationale: Fishing is identified in the 1997 Improvement Act as one of six priority public uses on refuges. This activity has occurred on the Refuge illegally at Harkins Slough Unit and resulted in incidental trails, damaged vegetation, and disturbance to wildlife. Therefore, the use should be analyzed to determine if it is compatible and can be allowed.

Strategies

7.4.1 Identify extent of existing use, impacts of use, challenges, and feasibility of fishing at Harkins Slough Unit.

7.4.2 Prepare a compatibility determination and, if compatible, prepare a fishing plan for the Harkins Slough Unit.

Objective 7.5 Within five years of Plan approval, provide interpretation, wildlife observation, and photography opportunities.

Rationale: Wildlife observation and photography are identified in the 1997 Improvement Act as two of six priority public use on refuges. The public will be encouraged to participate in self-guided trails for hiking on the Harkins Slough Unit and guided walks on units closed to the public.

Strategies

7.5.1 Provide a parking area, bilingual informational kiosk, and trails at the Harkins Slough Unit.

7.5.2 Create and install self-guided interpretive infrastructure along trails at Harkins Slough Unit.

7.5.3 Lead at least one interpretive or informational walk annually at Harkins Slough and Ellicott Units, and at Buena Vista property after memorandum of agreement with CDFG is finalized.

7.5.4 Install bilingual information signs in front of closed units.

7.5.5 Develop and produce a general brochure and website about the Refuge.

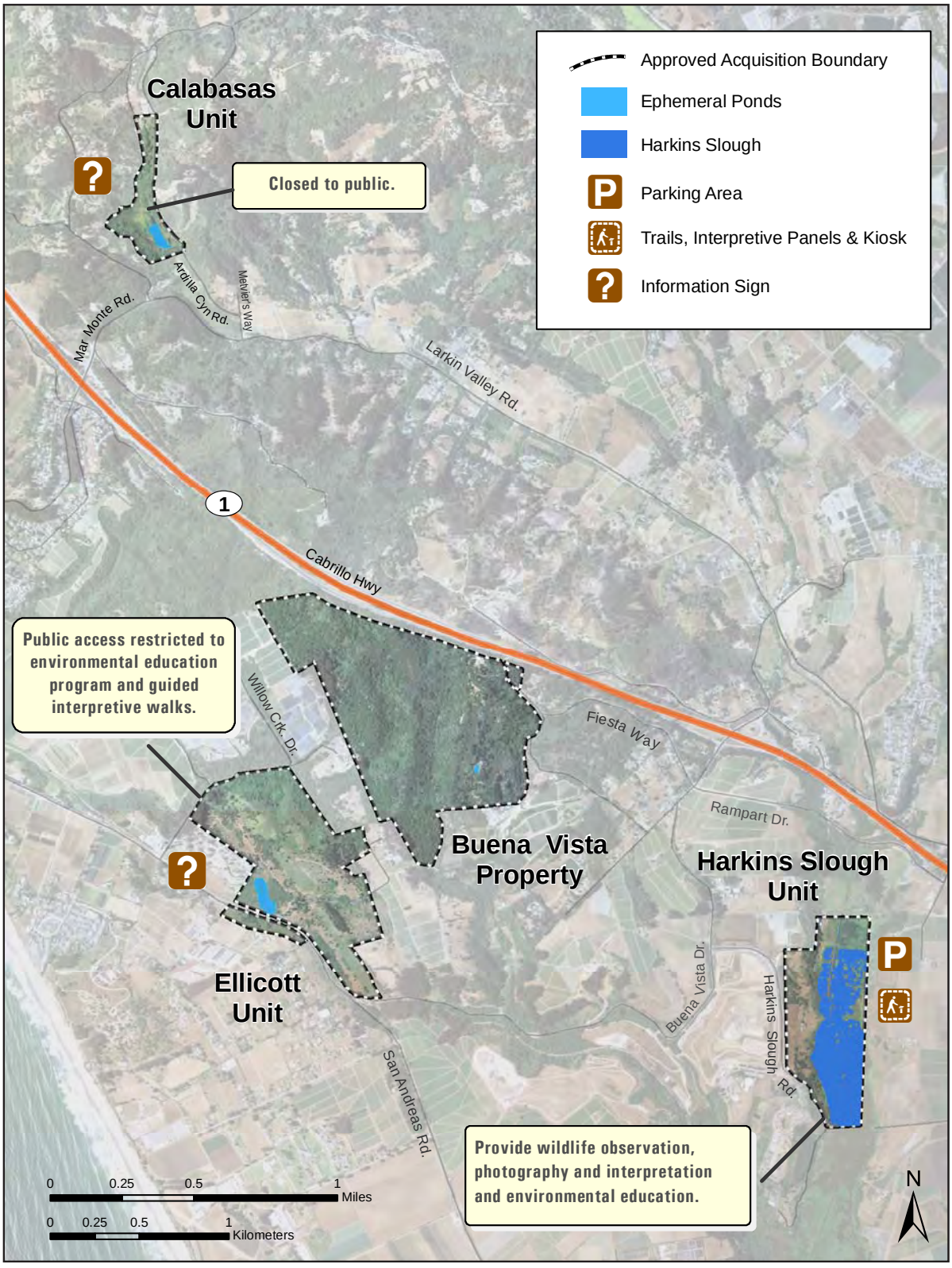
7.5.6 Monitor impacts of wildlife observation and photography on Refuge resources.

7.5.7 Develop a Visitor Services Plan.

Objective 7.6 Offer volunteer opportunities to promote stewardship and appreciation of the Refuge.

Rationale: Due to staff size, the Refuge relies heavily on volunteer staff to conduct biological and maintenance needs. The National Wildlife Refuge System Volunteer and Partnership Enhancement Act of 1998 (P.L. 105-242) identifies the importance of volunteers and strengthens the Refuge System's role in developing relationships with volunteers. Volunteers possess knowledge, skills, and abilities that can enhance the scope of refuge operations. Volunteers and Friends Organizations may have a local understanding of community needs and how the Refuge may conduct outreach to the community.

Figure 10. Visitor Services at Ellicott Slough NWR



Strategies

7.6.1 Provide volunteer opportunities, such as plant propagation, planting, invasive plant removal, plant surveys, and wildlife surveys.

7.6.2 Work with local National Audubon Society, wildlife, photography, and other organizations to offer joint walks, talks, and volunteer opportunities.

7.6.3 Support the development of a Friends Organization within the local community.

Objective 7.7 Continue the field-based program with Renaissance High School, and expand environmental education program to the other local elementary, middle, and high schools.

Rationale: Environmental education is identified in the 1997 Improvement Act as a priority public use that can be allowed when compatible with other Refuge purposes. To support this priority public use, the Service staff will work with local schools to bring children to the Refuge. Local schools are surrounded by an urban environment and have few opportunities to access natural settings. Conducting an environmental education curriculum on site is intended to allow children to promote self-discovery and experience the natural environment of the Monterey Bay area. The Refuge will partner with others to conduct in-class programs to prepare students for their field-based experience at the Refuge. The program curriculum will be aligned to the current Federal, state, and local standards. The environmental education program will be managed in accordance with Service Manual 605 FW 6 Environmental Education.

Strategies

7.7.1 Develop a field-based environmental education program at Ellicott and Harkins Slough Units that meets California state education standards.

7.7.2 Collaborate with partners (e.g., Watsonville Wetland Watch) to expand the in-class environmental education curriculum (e.g., develop amphibian life cycle curriculum) to other local schools.

7.7.3 Monitor impacts of environmental education on Refuge resources.

Objective 7.8 Continue and expand environmental programs and outreach to the local community and organizations through at least two outreach events annually.

Rationale: In 2007, the Service declared that "connecting people with nature" is among the agency's highest national priorities (USFWS 2008). A connection with nature, whether it's hiking, fishing, camping, hunting, or simply playing outside, helps children develop positive attitudes and behaviors towards the environment. Positive interactions with the environment can lead to a life-long interest in enjoying and preserving nature. People's interest in nature is crucial to the Service mission of conserving, protecting, and enhancing populations of fish, wildlife, plants, and their habitats.

Strategies

7.8.1 Conduct off-site presentations to community groups and universities to promote support for Refuge resources.

7.8.2 Create and maintain a Refuge website (see Strategy 7.5.5).

7.8.3 Develop outreach to the local community through mailings and newsletters.

7.8.4 Provide outreach at local festivals (e.g., Migration Festival).

7.8.5 Contact the regional Connecting People with Nature team and seek advice and/or recommendations on ways to connect people to the Refuge lands.

Chapter 6. Plan Implementation

Once the CCP has been approved and the Service has notified the public of its decision, the implementation phase of the CCP process will begin. During the next 15 years, the objectives and strategies presented in this CCP will be implemented; the CCP will serve as the primary reference document for all Refuge planning, operations, and management until it is formally revised at the end of the 15-year period. The Service will implement the final CCP with assistance from existing and new partner agencies and from organizations and from the public.

CCPs provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service's best estimate of future needs. These plans detail program planning levels that may exceed current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. Plans do not guarantee a commitment of resources.

Activities required to accomplish the management strategies discussed in this CCP are referred to as projects. Every effort will be made to implement these projects by the deadlines established here. However, the timing of implementation of the management activities proposed in this document is contingent upon the following factors:

- Funding
- Staffing
- Completion of step-down management plans
- Compliance with other Federal regulations
- Partnerships
- Results of monitoring and evaluation

6.1 Funding and Staffing

To implement the proposed action and to achieve the objectives and goals of this CCP, the Service will need additional funding. Needs are recorded in the Service Asset Maintenance Management System and Refuge Operating Needs System (RONS) for the Refuge System. Maintenance projects include repair and replacement of existing buildings and facilities and removal of unneeded infrastructure. RONS projects are proposed new Refuge projects that do not represent replacement of existing equipment or facilities. RONS projects for this Refuge include habitat restoration, wildlife monitoring, and visitor services programs. It is important to note that additional projects proposed in this CCP will be added to the RONS list during the life of this CCP. An estimated $2,200,000 in initial capital outlay is needed to implement projects in the CCP based on 2010 dollars (Table 6). The estimated annual cost to fully implement the CCP is $383,891 (Table 7). However, costs must be incrementally increased for inflation and additional activities such as new research studies.

The Refuge is managed as a satellite refuge within the San Francisco Bay NWR Complex. While the Refuge manager and wildlife biologist are permanently assigned to Ellicott Slough NWR duties, the Refuge also receives law enforcement, maintenance, environmental education, and administrative assistance from staff that support the entire Refuge Complex. Salaries constitute a significant cost of implementing the CCP. Funding for four additional permanent staff is needed to implement the objectives and strategies of the CCP (Table 7).

The needs and costs shown in Tables 6 and 7 are best estimates and may not entirely reflect the costs of managing the Refuge. The expenditures are followed by a reference to the number of the strategy (from Chapter 5) that expenditure implements or supports.

6.2 Step-Down Management Plans

Some objectives in the CCP require more detailed planning than the CCP process is designed to provide. For these projects, the Service will refer to step-down management plans and other plans to

Table 6. Estimated initial capital outlay to fully implement the CCP

Expenditure (related strategies)	Unit Cost	Priority
Conduct pond and upland drift fence and pitfall trap surveys to determine baseline population size and movement trends (includes 3 sites, for 3 consecutive years, at ~$45,000 per each survey). (1.1.5.3)	$400,000	1
Materials needed to conduct new baseline wildlife surveys. (1.1.5.2, 1.1.5.4, 2.1.3, 2.1.5, 4.2.1)	$45,000	1
Conduct hydrological and soil surveys for existing ponds to inform management actions. (1.2.2)	$75,000	1
Conduct hydrological and soil surveys for potential future pond locations. (1.2.3)	$75,000	3
Continue the planning and redesign of existing, non-functional breeding pond (Prospect Pond), and complete required NEPA, ESA, and Federal Coastal Zone Management Act compliance and permitting. (1.2.5)	$250,000	2
Conduct a hydrological assessment of Harkins Slough. (1.3.1)	$125,000	2
Understand and determine (through surveys and research) sources of contaminants, effects, and prevalence. If warranted, plan and implement a course of action to decrease exposure to affected areas. (1.4.4)	$100,000	1
Materials needed for GIS system and mapping. (2.1.2, 3.1.3, 3.2.1)	$20,000	1
Conduct plant surveys and mapping of the entire Refuge; sample a sub-set area at each refuge unit every 3–5 years thereafter. (3.2.3)	$40,000	1
Within 5 years of the Plan, develop a Habitat Management Plan including an adaptive Habitation Management Plan. (3.3)	$75,000	1
Remove hazardous fuel loads through manual, grazing, mechanical, and prescribed burn methods. (5.2.5)	$80,000	1
Conduct flood-risk and climate-risk analysis of lands on and adjacent to the Refuge. (6.1.1)	$50,000	2
Assess effects of climate change on disease outbreaks and parasites (e.g., monitoring presence of Rana viruses and chytrid in amphibians in relation to rising ambient and pond water temperatures). (6.1.8)	$20,000	1
Assess saltwater intrusion (i.e., effects on plants, wildlife) for Harkins Slough as a result of sea-level rise. (6.1.9)	$50,000	3
Cap existing wells in accordance with state regulations prior to allowing public access at Harkins Slough Unit. (7.1.1)	$100,000	1
Remove existing abandoned buildings prior to allowing public access at Harkins Slough Unit. (7.1.2)	$150,000	1
Install gate at Harkins Slough Unit for staff access. (7.1.3)	$10,000	1
Provide parking areas, bilingual informational kiosk, and trails at Harkins Slough Unit. (7.5.1)	$270,000	1
Create and install self-guided interpretive infrastructure along trails at Harkins Slough Unit. (7.5.2)	$30,000	2
Install bilingual information signage in front of closed units. (7.5.4)	$30,000	3
Develop and produce a general brochure and website. (7.5.5, 7.8.2)	$20,000	1
Develop field-based environmental education program at Ellicott and Harkins Slough Units that meets California state education standards. (7.7.1)	$35,000	1
Conduct boundary surveys of the Ellicott and Harkins Slough Units and Buena Vista, and install additional boundary fencing and/or signage. (in support of Goals 1,2,3,4,5 and 7)	$150,000	1
Total Ellicott Slough NWR (estimated capital outlay)	**$2,200,000**	

Table 7. Estimated annual cost to fully implement the CCP[1]

Expenditure	Status	Unit	Quantity	Total Cost[2]
Salaries and Benefits[2]				
Refuge Manager – GS-11	Existing	FTE	0.5	$48,593
Wildlife Biologist – GS-9	Existing	FTE	0.5	$41,379
Maintenance Worker – WG-7/8 To fulfill Goals 1,2,4,5, and 7	Proposed & unfunded	FTE	0.5	$34,828
Outdoor Recreation Planner – GS-7/9 To fulfill Goal 7	Proposed & unfunded	FTE	0.5	$36,512
Park Ranger/Law Enforcement – GS-7/9 To fulfill Goals 1,2,3,5, and 7	Proposed & unfunded	FTE	0.5	$37,729
Biological Technician – GS-5/7 To fulfill Goals 1,2,3, and 4	Proposed & unfunded	FTE	0.5	$29,850
Subtotal Salaries and Benefits - Ellicott Slough NWR		***FTE***	***3.0***	***$228,891***
Expenditure				**Total Cost**
Programs				
Maintenance (repairs, replacement, rentals, etc.)				$75,000
Invasive Weed Program (herbicide, materials, contract, equipment repairs and replacements)				$50,000
Amphibian Monitoring Program				$15,000
Environmental Education Program				$15,000
Subtotal Programs - Ellicott Slough NWR				***$155,000***
TOTAL - Ellicott Slough NWR (annual salaries and benefits budget and annual programs budget)				**$383,891**

[1] Staffing and funding would be sought over the 15-year life of this Plan subject to approval and funding by Congress.

[2] Estimates are based on 2010 salary levels with 30% added for benefits. Existing salaries are calculated using the current grade and step level of the position; proposed salaries are calculated using the highest grade the position will attain at a step 1 level. All positions are shared with Salinas River NWR (i.e., 0.5 FTE for Salinas River NWR).

provide additional details necessary to implement objectives and strategies in the CCP. A number of step-down plans will be developed or updated after completion of the CCP, including:

- Fire Management Plan (last updated 2002)
- Mosquito Management Plan
- Habitat Management Plan
- Water Management Plan
- Visitor Services Plan

6.3 Compatibility Determination

Federal law and policy provide the direction and planning framework to protect the Refuge System from incompatible or harmful human activities and to ensure that Americans can enjoy Refuge System land and waters. The 1997 Improvement Act is the key legislation on managing public uses and compatibility.

Before activities or uses are allowed on a refuge, uses must be found to be compatible through a written compatibility determination. A *compatible use* is defined as a proposed or existing wildlife-dependent recreational use or any other use of an national wildlife refuge that, based on *sound professional judgment*, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the refuge. Sound professional judgment is defined as a decision that is consistent with the principles of the Service's management and administration, available science and resources, and adherence to the requirements

of the 1997 Improvement Act and other applicable laws. Wildlife-dependent recreational uses may be authorized on a refuge when they are compatible and not inconsistent with public safety.

Compatibility determinations for environmental education and interpretation, mosquito management, research, and wildlife observation and photography are included in Appendix G.

6.4 Compliance Requirements

This CCP was developed to comply with all Federal laws, Executive orders, and legislative acts. For information on applicable laws and regulations, see the Legal and Policy Guidance section in Chapter 1.

6.5 Partnership Opportunities

Volunteer and Friends Organizations efforts are critical to the achievement of Refuge objectives and strategies. The Refuge has partnered with governmental agencies, nongovernmental organizations, and individuals to conduct wildlife monitoring, habitat restoration, and facility maintenance activities. These partners play an important role in helping the Service achieve its mission and the Refuge's goals. The Service will continue to rely on these and other partners in the future to help implement this CCP and to provide input for future CCP updates. In addition, the Service will continue to explore other potential avenues for partnerships and assistance in the monitoring and restoration of the Refuge.

6.6 Monitoring and Evaluation

This CCP is designed to be in effect for a 15-year period. The Plan will be reviewed and revised as necessary to ensure that established goals and objectives are still applicable. The monitoring program will focus on issues involving visitor services activities, habitat restoration, wildlife monitoring, and other management activities. Monitoring and evaluation will use the adaptive management process. This process includes goal and objective setting, and applying management tools and strategies, followed by monitoring and analysis to measure achievement of objectives and to refine management techniques.

Collection of baseline data on amphibian and other native wildlife populations will continue. This data will be used to update existing species lists, determine habitat requirements, and guide management actions. Where information gaps exist, a concerted effort will be made to obtain information. With new information, goals and objectives may need modification. Public involvement will be encouraged during the evaluation process.

Monitoring of visitor services programs will involve the collection of visitor use statistics. Monitoring will be done to evaluate the effects of visitor services on Refuge habitat, wildlife populations, and visitor experience.

6.7 Adaptive Management

Adaptive management is characterized by management that monitors the results of policies and/or management actions and integrates this new information, adjusting policy and management actions as necessary (Jacobson 2003). Adaptive management promotes flexible, effective decision making that can be adjusted in the face of uncertainties as outcomes of management actions and other events become better understood. Careful monitoring of these outcomes advances understanding of the system and helps adjust policies. Adaptive management incorporates natural variability in evaluating ecological resilience and productivity (Trulio and Clark 2005).

Adaptive management provides the framework within which biological measures and public use can be evaluated by comparing the results of management to the expected results of objectives. Under the CCP, habitat, wildlife, and public use management techniques and specific objectives would be regularly evaluated as the results of monitoring programs, new technology, and other information become available. These periodic evaluations would be used over time to adapt both the management objectives and the strategies to better achieve management goals. Such a system embraces uncertainty, reduces option foreclosure, and provides new information for future decision making, while allowing resource use. The management scenario proposed in this CCP provides for ongoing adaptive management of the

Refuge. The CCP may be amended as necessary at any time in keeping with the adaptive management strategy. However, major changes to the CCP may require public involvement processes and additional NEPA compliance documentation. The Refuge manager will determine the appropriate public involvement and NEPA compliance requirements. Plan revisions are discussed in the next section.

6.8 Plan Amendment and Revision

The CCP is intended to evolve as the Refuge changes; to this end, the 1997 Improvement Act specifically requires that CCPs be formally revised and updated at least every 15 years. The formal revision process would follow the same steps as the CCP creation process. In the meantime, the Service will review and update this CCP periodically if needed, based on the results of the adaptive management program. While preparing annual work plans and updating the Refuge database, Refuge staff will also review the CCP. It may also be reviewed during routine inspections or programmatic evaluations. Results of any or all of these reviews may indicate a need to modify the Plan. The goals described in this CCP would not change until they are reevaluated as part of the formal CCP revision process. However, the objectives and strategies may be revised to better address changing circumstances or to take advantage of increased knowledge of the resources on the Refuge. It is the intent of the Service that this CCP apply to any new lands that may be acquired as part of the Refuge. If revisions to the objectives and strategies are needed, the Refuge manager will determine the appropriate public involvement and associated NEPA compliance requirements.

The intent of the CCP is for progress toward and/or achievement of Refuge objectives during the lifetime of the Plan. Management activities would be phased in over time, and implementation is contingent upon and subject to the results of monitoring and evaluation, funding through Congressional appropriations and other sources, and staffing.